National Research Council of Canada

DESIGN AND CONSTRUCTION OF PEAT SLURRY PUMP/MACERATOR

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Monenco Peat Group
Monenco Consultants Ltd.
155 Rexdale Blvd.
Rexdale, Ontario
M9W 5Z8

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ABSTRACT

Construction of a new design of peat slurry pump/macerator consisted of the following stages:

- review of previous designs of USSR peat slurry pumps, materials of construction, tolerances, to develop basic peat slurry mining pump parameters;

- discussion with numerous pump manufacturers regarding their interest, capabilities (skills and fabricating) and ideas on basic design requirements. A peat slurry pump specification was prepared by Monenco;

- several pump manufacturers submitted proposals to Monenco ncluding costs to fabricte a pump to Monenco specifications or to supply a pump to near specification. Allis-Chalmers Inc. was selected as the manufacturer offering a proposal which conformed closest to the Monenco specification;

- the pump design and fabrication aspects were reviewed in detail with the selected manufacturer (Allis-Chalmers Inc.) and various potential operational problems discussed, e.g. air entrainment, air evacuator valve requirement, problems of stumps and roots, etc. A final design review and fabrictaion schedule was established;

- fabrication of the pump components and assembly of the pump; and

- shop tests on water by the manufacturer to determine pump performance characteristics.

RÉSUMÉ

Les étapes de la construction du nouveau modèle de macérateur/pompe à suspensions de tourbe ont été les suivantes :

- examen des divers modèles existants de pompes à suspensions de tourbe d'URSS, matériaux de construction et tolérances, pour déterminer les paramètres de base de pompes d'extraction des suspensions de tourbe;

- discussion avec de nombreux fabricants de pompes pour connaître leurs intérêts, capacités (compétences et matériel de fabrication) et idées quant aux exigences de base en matière de conception. Une liste de spécifications pour une pompe à suspensions de tourbe a été préparée par Monenco;

- plusieurs fabricants de pompes ont soumis à Monenco des offres précisant les coûts de fabrication d'une pompe plus ou moins conforme aux spécifications de Monenco. L'offre d'Allis-Chalmers Inc. a été retenue comme répondant le mieux aux spécifications de Monenco;

- les détails de conception et de fabrication de la pompe ont été examinés avec le fabricant sélectionné (Allis-Chalmers Inc.) et divers problèmes techniques potentiels ont été discutés, par ex. entraînement d'air, nécessité de purgeurs d'air, problèmes posés par les souches et les racines, etc. Un calendrier final d'étude de conception et de fabrication a été établi;

- fabrication des éléments de la pompe et assemblage de la pompe; et

- essais en atelier avec de l'eau, par le fabricant, pour déterminer les caractéristiques de performance de la pompe.

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INTRODUCTION

This work represents the second phase of a multi-phase program undertaken by The National Research Council of Canada to study wet peat mining methods and the pumping and pipeline transport of peat slurry, and to include:

Phase 1 - Development of Design Parameters for Peat Slurry Pumping and Pipeline Transport;

Phase 2 - Design and Construction of a Peat Slurry Pump/Macerator; and

Phase 3 - Peat Slurry Pumping Trials

The Phase 1 report was completed during May, 1985 and described in detail the previous USSR experience on peat slurry pumping and outlined laboratory methods for determining degree of decomposition of peat and peat slurry viscosities. A correlation was made between Russian and North American peatland and peat types, in order to compare results. The report also included methods for calculating the main peat slurry pumping parameters, based on the knowledge of the peat characteristics.

This report has involved a review of the various designs of peat slurry pumps, numerous discussions with North American, European and Japanese pump manufacturers, preparation of a new design of peat slurry pump, fabrication and shop testing of the proto-type unit on water. Pump performance on water exceeded Monenco's original design requirements. The unit was designed to operate at an industrial-scale (e.g., capacity 2,000-4,000 USGPM). The peat slurry pump has several unique features including an external propeller to repel roots, stumps and other debris and an internal macerating unit to prepare the peat, with a minimum energy input, into a form which renders it suitable for

pumping and pipeline transport and later formation of a peat product. Third phase work is expected to include field testing of the unit under various actual peatland and peat type conditions.

Monenco had access to information (including detailed design specifications) on several previous models of peat slurry pumps, which were developed in the USSR over a period of about forty years. The Russian designs were reviewed, as well as previous materials of construction and tolerances, with selected pump manufacturers and a new/modified pump design was prepared. The basic design requirements included:

- capability for maximum cutting, grinding and macerating of the raw peat feedstock;

- use of modern metals, of lightweight construction; and

- maximum pump capacity and minimum pumping losses.

The statement of work for the project outlined the following main project tasks:

- review of the previous USSR pump designs, pump characteristics and pump performance on different peat types;

- preparation of technical specifications for the peat slurry pump;

- discussions with several pump manufacturers to determine interest, engineering skills, manufacturing capability and costs for their assistance in the design and fabrication of a slurry pump;

- selection of a pump manufacturer to fabricate the peat slurry pump;

- final selection of the preferred pump design, further detailed design calculations and modifications to existing design(s), to select materials of construction and to determine the compatibility of the pump with air evacuation requirements;

- fabrication of the new peat slurry pump/macerator; and

- shop testing of the unit to develop performance characteristics on water.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

1. If a single key parameter can be indicated which experience has shown is essential for both the technical and economic success of the conventional peat slurry pumping system, it would be maceration of the peat within the slurry. Monenco studied the various aspects of wet peat mining technology for some time and considered various configurations of macerator and slurry pump, many of which were tried before in Europe. However, only the Russian peat slurry pump was a piece of proven equipment and was recommended for demonstration testing.

2. The uniqueness of the Russian peat slurry pump design is the inclusion of a stump and roots deflector exterior to the pump, and the cutting wheels in the macerator section of the pump, required to achieve the desired degree of maceration.

3. The review of previous designs of USSR peat slurry pumps, performance characteristics and materials of construction tolerances were conduced to develop a detailed design specification for the fabrication of the peat slurry pump.

4. Although discussions were held with a number of pump manufacturers, and many novel ideas were put forward, including various configurations of macerator and/or pump, only Allis-Chalmers Canada Inc. offered to design and construct a model similiar to the previous Russian peat slurry pump.

5. The Allis-Chalmers pump design was based on a previous design of variable capacity fan pump (ACAP) for feeding paper stock into paper machines. The ACAP pump had a varied capacity developed

by internal recirculation. This was acomplished by changes in the clearance between the open impeller and the wear plate. It was found that by increasing the wear plate clearance, the pump could pump a feedstock with a higher consistency and could also increase the air handling ability. The new design of peat slurry pump/macerator also has the capability to increase the clearance of the wear plate.

6. The Allis-Chalmers design incorporated the following:

- enlarged inlet/macerator to reduce the tendency to plug;

- modification of the casing to a 14" connection matching the 14" macerator;

- the clearance between the impeller and wear plate was set initially at 1" to allow enough recirculation to dislodge any entrained air bubbles forming at the impeller eye. This clearance was varied from 0.03 inches to 1.0 inches;

- V-belt drive arrangement to allow vertical mounting of a standard 150 HP, 1800 rpm motor and a pump speed of 1000 rpm. This arrangement allowed modification of the speed which, together with the pump clearance adjustment, permitted a number of speed/clearance variations to experiment with increased solids concentrations (Allis-Chalmers provided pulleys for 600, 800 and 1000 rpm pump operation);

- a lower water-lubricated bearing and upper thrust bearing mounted on the floor plate;

- the clearance measured from the inlet to the static knife to the propeller was increased from 2½ to 4½ inches, to avoid build-up of peat, roots and other debris;

- the clearance between the forwarding guide and the axial wheel, and between the static knife and the axial wheel can be adjusted so that the maximum clearance is never greater than 1.0 mm;

- the grease cup arrangement was converted to water lubrication by simply connecting a water supply to the grease system. It was estimated that the system required 2-3 USGPM of clean water.

- the materials used for the main parts of the pump/macerator were as follows:

  - pump casing, sideplate, stuffing box cover, bearing housing - cast iron
  - impeller - stainless 316SS
  - column and floor plate - mild steel
  - deflector/macerator assembly - stainless CA6NM;

7. A shop performance test of the peat pump/macerator was carried out to determine its performance on water at 1000 rpm, 800 rpm and 600 rpm. Tests were carried out with minimum wear plate clearance at 1000 rpm to determine the maximum head and horsepower absorbed by the pump. All other tests were carried out with the maximum 1" wear plate clearance to determine the minimum head and efficiency produced by the pump/macerator at these conditions. The stump deflector was removed during the last test to determine how much horsepower it absorbed.

8. The water tests demonstrated that the pump/macerator was manufactured in accordance with Monenco's original performance specification and no difficulty was encountered in pumping water and no deficiencies or malfunctions observed worthy of note.

9. The overall efficiency of the unit for Test #1 at 1000 rpm with 0.03" wear plate clearance was 60.5% (Appendix D, Figure D-5), at the best efficiency point (BEP), which is considerably higher than any of the other known peat pump/macerator designs. This higher efficiency was attributed to the high efficiency of the Allis Chalmer's basic pump design which is about 81% at BEP.

The efficiency decreased to 33.2% as expected for Test #2, (Appendix D, Figure D-8), when the wear plate clearance was increased to 1" (maximum clearance). This decrease in efficiency was due to recirculation within the impeller. It is expected that the wear plate adjustment feature will allow higher concentrations of peat slurry to be pumped and also overcome air-binding of the pump due to high air entrainment in the peat.

10. It was expected that the macerator and stump deflector would increase the power consumption of the unit, but that some of the work expended in driving the macerator and stump deflector would result in a higher head produced by the pump. This was not so. The head produced by the pump for Test #1 was very similar to head produced by the pump without the macerator but the horsepower increased by 33% approximately at the BEP (Appendix D, Figure D-18). It was also interesting to note that the flow at BEP increased from 3000 USGPM to 4000 USGPM. This may be due to the suction inlet being increased from 10" to 14" diameter.

However, for the other test, the head was lower than expected (Appendix D, Figures D-19 to D-21). This may be due to the head loss for the stump deflector and macerator not being proportional to the square of the speed which is the case for the head produced by the pump, resulting in the macerator loss becoming a large percentage of the total head produced by the pump. Appendix D, Figure D-22 shows that, at BEP, the head decreases by 9% when the stump deflector is removed.

11. Plotting the velocity vibration readings on the General Machinery Severity Chart, Appendix D, Fig. D-23, indicated that there were no basic mechanical dynamic deficiencies and the majority of the readings were in the good and very good range, and with one reading at low flow in the fair range which could be expected at the low flow of 546 USGPM. Some readings at other flows were even in the extremely smooth range.

12. Field testing under actual peatland conditions will be required to determine final effectiveness of the pump and macerator design on peat slurry and to determine how design improvements can be made.

PART 1. PEAT SLURRY PUMP DESIGN REVIEW

1.1 REVIEW OF PREVIOUS USSR PEAT SLURRY PUMP DESIGNS AND MAIN COMPONENTS

It appears, after an extensive search for detailed information on peat slurry pumps, that the only available information on the subject can be found in the USSR peat mining engineering handbooks and publications (1,2,3,4,5,6,7,8,9,10). These books and articles provide information on Russian experience regarding the fabrication of peat slurry pumps over a period of 40 years. Only recently has some information on peat slurry pumping and wet peat mining methods been published in North America (11,12,13,14,15,16).

The peat slurry suction pump is the main mechanism used in the previous "hydropeat" method of wet peat mining. Its purpose is to extract the peat slurry from the mining pit, to mix and macerate it (additional to the hydromonitoring operation) and to pump the slurry through a pipeline to a reservoir. The first USSR models (years 1926, 1929, 1931, 1938) of peat slurry suction pump were used together with a macerator, located separately. The pump pumped the peat slurry a distance of 12-15 m to the macerator which, in turn, not only provided additional processing, but also pumped it farther to the reservoir using a built-in centrifugal pump. The design of these pumps and macerators, and also their performance characteristics, are shown in Appendix A, Figures A-1 through A-19. The general arrangement of the whole hydropeat mining system is shown in Appendix A, Figure A-20.

Many design modifications and improvements were made over more than 20 years of industrial operation, and a peat slurry suction pump (model TPD) was developed in which the pump and macerator were an integral unit. This peat mining system conveyed the peat slurry a distance of approximately 1-2 km from the mining pit through a pipeline directly to the reservoir. Several designs of TPD model pumps and their performance characteristics, are shown in Appendix A, Figures A-21 through A-24.

The New Standard TPD pump models were used to pump peat slurry through steel pipelines of 570 mm diameter. The Super Standard TPD models pumped peat slurry through steel pipelines of 680 mm and 755 mm diameters. The technical parameters of the peat slurry pump/macerator (model TPD-4A) are shown in Table 1-1.

A general view of the peat slurry pump/macerator (model TPD-4A) is shown in Appendix B, Figure B-1, and its performance characteristics are shown in Appendix B, Figure B-2. The pump consists of two sections; lower (suction) and upper (centrifugal) parts. The function of the lower section is to extract the peat slurry from the funnel of the mining pit and to grind, macerate and mix it. The function of the upper section is to pump the peat slurry to the reservoir, normally located about 1-2 km from the mining area. The design of the lower section includes the elements of an axial pump and macerator while the design of the upper section includes the centrifugal well.

The lower section of the pump/macerator consists of the following parts (Appendix B, Figure B-1); 1-stump deflector, 2-static knife, 3-axial wheel, 4-shell, and 5-forwarding guide.

111 THE STUMP DEFLECTOR

The general view of the stump deflector is given in Appendix B, Figure B-3. The stump deflector has 2 blades, fabricated from stamped steel and fixed on the shaft by threads. The body of the stump deflector and its blades have symmetric, streamlined profiles. The purpose of the stump deflector is to prevent clogging at the suction inlet by deflecting all incoming stumps, roots and blocks of moss peat (not broken up by the water-jets). Its function also includes keeping all the solid particle of peat in suspension.

Industrial experience has shown that the power requirement for the stump deflector, for the model TPD-4A pump, was about 5-6 kw. The comparative performance curves for the peat slurry pump in operation, with and without the stump deflector, are plotted in Appendix B, Figure B-4.

112 THE STATIC KNIFE

The general design of the static knife is shown in Appendix B, Figure B-5. The static knife has three radial blades, and is made of steel casting. The exit edges of the blades are also fabricated of special alloys.

A radial roller bearing is installed in the body of the static knife to unload the radial forces. The clearance dimensions between the static knife and the cutting edges of the axial wheel should be limited to 0.25-0.3 mm during fabrication and not more than 1.0 mm during mining operations (including wear). The regulation of the clearance dimensions is achieved by adjusting the shims (Appendix B, Figure B-1, No. 15) between the static knife and the cutting edges of the axial wheel.

113 THE AXIAL WHEEL

The general design of the axial wheel is shown in Appendix B, Figure B-6. While rotating between the static knife and the forwarding guide, the axial wheel cuts and grinds peat fibers and small pieces of stumps and roots, using the cutting edges of its blades. The axial wheel is of casted steel and has four blades. The entrance edges of blades are shaped as cutters, and to increase their wear resistance, they are made of special alloys. To strengthen the axial wheel while cutting small scumps, the blades are embraced by the wheel

rim. On the surface of the rim, special grooves of a triangular shape are provided, as shown in Appendix B, Figure B-6, to ensure that a dense "belt of fibers" is not formed in the clearance between the external diameter of the axial wheel and the internal diameter of the shell.

114 THE FORWARDING GUIDE

A general view of the forwarding guide is given in Appendix B, Figure B-7. The forwarding guide has five vanes and is fabricated from a steel casting. The entrance edges of the blades are shaped as a cutter and made of special wear-resistant alloy. On the internal surface of the shell, there are special, triangular-shaped grooves as mentioned earlier, and shown in Appendix B, Figure B-7.

The clearance between the forwarding guide and the axial wheel should not exceed 0.25-0.3 mm during fabrication, and not more than 1.0 mm during the mining operation (including wear). Otherwise, the quality of maceration of the peat slurry will decrease, and clogging of the inlet of the peat slurry pump may occur.

Control of the clearance dimension is achieved by adjusting the shims (Appendix B, Figure B-1, No. 15) between the forwarding guide and the shaped ring, and between the forwarding guide and the axial wheel.

115 IMPELLER

The upper section as mentioned earlier, consists of an adjusting or shaped ring as shown in Appendix B, Figure B-1, (6), centrifugal wheel (7), spiral chamber (8), transition chamber (9), bearings (11, 12 and 13) and flexible coupling (14).

The general view of the impeller (centrifugal wheel) is shown in Appendix B, Figure B-8. The centrifugal wheel has four blades and is made of casted steel. Control of the clearance between the centrifugal wheel and the shaped ring is achieved by adjusting shims between the shaped ring and the spiral chamber.

1.2 SPECIFIC FEATURES OF HYDRAULIC CALCULATIONS FOR PEAT SLURRY PUMP/MACERATOR

The hydraulic design of the peat slurry pump is based on similar hydraulic calculations for water pumps. However, due to the specific characteristics of peat slurries, peat slurry pumps have some design features that differ from water pumps. Therefore, it is necessary to include certain corrections into the hydraulic calculations.

The common feature of all peat slurry pumps (as well as other pumps designated for operation with sewage and dense liquids) is the increased flow area in the impeller and diffusers. The increase in flow area in the vane channels is achieved by an increase in the width of the meridian flow areas, by a reduction of the number of vanes and by a decrease in the vane wrap angle. Widening of the meridian flow areas causes a decrease in the peat slurry flow velocities and it is one of the main factors for the lower hydraulic efficiency of peat slurry pumps. There is a certain minimum flow area required to prevent clogging of the pump.

The most important design feature of the peat slurry pump is the profile (configuration) of the vanes of the various components of the macerating unit such as the static knife, axial wheel and forwarding guide. Due to the small number of vanes and the low slurry velocities along the vanes of the axial wheel and impeller, the hydraulic efficiency is low, approximately 0.55 to 0.7 for the axial wheel

(depending where measured) and 0.72 for the impeller. Also, the efficiency of the peat slurry pump is decreased due to the additional mechanical losses caused by the friction of the axial wheel rim and the stump deflector within the peat slurry.

1.3 PEAT SLURRY PUMP/MACERATOR DESIGN REQUIREMENTS

Several models of USSR pumps were reviewed, including design details of the model TPD-4A pump/macerator (axial wheel, forwarding guide, static knife, stump deflector, centrifugal wheel). Additional information was also prepared on the performance characteristics, in industrial applications, of the various models of peat slurry pump with and without the macerator and propeller, and on the comparison of pumping characteristics of different types of peat, solids contents and viscosities of peat slurry and on the pumping characteristics of water. Also, new additional information was translated on the flow characteristics of peat slurry in pipelines of 570 mm and 755 mm diameter at different solids concentrations and viscosities of peat slurry.

USSR industrial experience showed that the peat slurry pump/macerator had design features that differed from usual slurry pumps. Therefore, it was necessary to translate the detailed hydraulic calculations concerning the flow parameters and selection of profiles and dimensioning of the impeller, impeller vane, special chamber, axial wheel and forwarding guide.

Monenco modified the previous design performance specification and the technical parameters for presentation to Allis-Chalmers Canada, Inc. who were selected as the preferred pump manufacturer. The pump/macerator was to be supplied with the following materials:

Pump Casing - Cast Iron
Pump Cover - Cast Iron
Pump Sideplate - Cast Iron
Pump Impeller - Stainless Steel
Pump Deflector - Stainless Steel
Macerator Assembly - CA6NM (275 BNH)

Allis Chalmers was requested to confirm the following parameters for the pump/macerator:

- maximum speed - 1,000 rpm
- weight (pump, base and motor) - approx. 5,000 lbs
- total length (shaft length) - 96.5 inches

The performance of the pump, based on water, was requested to be as per curve P-001 as shown in Appendix C, Figure C-9. Shop tests were requested to develop several variable speed curves, one set with standard clearance and one set at one inch clearance and between wear-plate and impeller. The pump was to be supplied with a V-belt drive, suitable for a 1,800 rpm motor and pump operation at 1,000 rpm. The pump was to be supplied with a lower radial-bearing, to be water and/or grease lubricated and with lifting eye-bolts located so that pump shaft could be suspended in the vertical plane.

TABLE 1-1

The Technical Parameters of Model TPD-4A
Peat Slurry Pump/Macerator

Items	Unit	Parameters
Pump Capacity	m3/hr	500 - 700 - 800
Dynamic Head	m water column	20.7 - 18.0 - 16.0
Efficiency		0.4 - 0.46 - 0.47
Brake H.P.	HP	72 - 73 - 74
Diameter of Axial Wheel	mm	450
Diameter of Centrifugal Wheel	mm	680
Diameter of Forwarding Guide	mm	450
Number of Axial Wheel Blades	pieces	4
Number of Centrifugal Wheel Blades	pieces	4
Number of Forwarding Guide Blades	pieces	5
Electric Motor:		
Power	kW	90
Speed	rpm	580
Weight:		
With Electric Motor	tonnes	3.92
Without Electric Motor	tonnes	1.85

PART 2. SELECTION OF PUMP MANUFACTURER

2.1 DISCUSSIONS WITH PUMP MANUFACTURERS

First, a list of pump manufacturers was compiled, concentrating mainly on manufacturers of slurry pumps for the mining industry. From the initial list of about 18 suppliers/manufacturers, companies were contacted including:

- Robbins & Myers,
- Allis-Chalmers,
- Worthington,
- Ingersoll Rand,
- Wemco,
- Goulds,
- Hayward Gordon,
- S.A. Armstrong, and
- Dorr Oliver.

Two overseas manufacturers were also contacted, namely IHC, Holland and Toyo of Japan (with representation in Vancouver). These manufacturers were contacted because information indicated that the Dutch manufacturer had some experience with peat and that Toyo had an existing pump rather close to the description of the former USSR model peat slurry pump.

The main criteria used in pre-selecting manufacturers for further discussions were related to:

a) their expression of interest in participating in actual fabrication of a Monenco-designed peat slurry pump;

b) whether they had manufacturing/fabricating facilities in Canada; and

c) the extent of the facilities, e.g. whether modifications and/or original proto-type models could be made and also whether performance testing on water could be carried out at the manufacturer's facility after the pump was fabricated.

The following discussions revealed that Dorr Oliver's slurry pump manufacturing division was in the United States and that its Barrie, Ontario plant did not have adequate test facilities, that Wemco did not have test facilities in Canada and that Goulds also did not have manufacturing facilities in Canada.

Early in June, 1984, a series of telexes were sent to the various manufacturers, who fulfiled the aforementioned pre-selection criteria, which included the following firms:

- Allis-Chalmers,
- Worthington,
- Robbins & Myers,
- Ingersoll Rand,
- Hayward Gordon, and
- S.A. Armstrong.

Allis-Chalmers, Hayward Gordon and Robbins & Myers replied favourably to the telex. Worthington cited lack of a potential market as a reason for declining to participate. S.A. Armstrong said that they could not participate due to current economic situations, and Ingersoll Rand declined, citing that the market for the type of pump under consideration was already dominated by two firms, namely Toyo and Sulzer. Correspondence was continued with the two overseas firms, IHC of Holland and Toyo the Japanese pump manufacturer represented in Vancouver.

Further meetings were arranged with Hayward Gordon, Robbin & Myers and with Allis-Chalmers. The purpose of the meetings was to

discuss in further detail both the pumping requirements/performance specifications and the mining requirements of the peat slurry/macerator pumping unit.

A meeting was held with Hayward Gordon in late June 1984, where Monenco discussed the role of the peat slurry pump in terms of the overall wet peat mining technique and Monenco also described at considerable length peatlands and peat, including samples of various types of peat. Previous peat slurry pumping practice in the USSR was described, including the main elements of the previous peat slurry pump and illustrations of various models were shown. The performance specifications were discussed in detail, as well as the assembly of the motor, the pump, the cutting blades, the macerator as well as various internal features of the pump such as the clearances and materials of construction.

None of the pump manufacturers had specific knowledge concerning peat slurry. Several were concerned about the location of the macerator on the suction end of the pump. It was thought that the macerator should be located beyond the discharge end of the pump. Monenco encouraged the manufacturers to present their own ideas, however, it was indicated that the USSR pump operated successfully for a long period of time (forty to fifty years) in the USSR.

The Hayward Gordon personnel felt that the only way that the pump project could be kept within reasonable constraints regarding time, and particularly budget, was to modify an existing pump, and therefore they presented information and brochures on pumps currently on the market. A pump which was shown, manufactured by Vaughn Pumps, was roughly similar in principle to the USSR pump. During the course of the meeting it was agreed that Hayward Gordon would return to their offices and consider further the possibility of modification of an existing design and associated costs and would submit their response to Monenco. Subsequently, Hayward Gordon decided not to submit, citing mainly a lack of market potential.

A meeting was held later (July 1984), with Robbins & Myers. Much of the same material as discussed with the previous manufacturers was reviewed with Robbins & Myers. Monenco had the benefit of previous discussions with Robbins & Myers, approximately one year prior, concerning the problems of pumping of peat and they were somewhat more familiar with the subject. The Robbins & Myers representatives indicated that their pump, namely the Moyno model, was better suited to slurries of higher viscosity than commonly encountered with the peat slurries as prepared by the water jet technique. However, their design was not well suited to the inclusion of a macerator of the type as used on the Russian model of peat slurry pump and therefore they could not submit. Monenco indicated that the water jet technology and the resultant rather low percent solid concentrations of peat slurry was being pursued inasmuch as it had been previously successful in the mining and transport of peat slurries. Innovative ideas such as an alternative arrangement of macerator and pump were encouraged, but it was stated that Monenco would have to be strongly convinced of a successful performance in a field trial. During further discussions, it was agreed that Robbins & Myers would submit a configuration of their own suggestion, which would be examined in detail.

During July, 1984, a meeting was also held with Allis-Chalmers who confirmed that they would be willing to design and fabricate a peat slurry pump/macerator. A previous quotation had been supplied for construction of a peat slurry pump. Allis-Chalmers personnel, including their pump specialists, had visited Monenco at that time and were familiar with the Russian model of peat slurry pump and had reviewed the drawings and submitted a proposed design of a modified peat slurry pump.

The performance specification was reviewed in further detail. Allis-Chalmers indicated that their design was based on a previous Allis-Chalmers pump used to handle paper stock. They indicated that the approach of modifying an existing pump design, with

similiar characteristics to the Russian model, preparation of patterns and castings could be carried out within the time frame allotted, namely 6 to 9 months, and at a reasonable cost. Allis-Chalmers stated that if they were required to prepare a complete design of pump and fabrication including detailed hydraulic analysis, the process could take 1 to 2 years and cost many orders of magnitude greater. The Allis-Chalmers modified pump was the closest of any of the manufacturers to the previous USSR design of pump/macerator. Allis-Chalmers agreed to respond with further details. Appendix C includes a copy of Allis-Chalmer's telex and letter proposals.

The IHC pump manufacturing facility in Holland was visited during June 1984 by a Monenco peat engineer and although they expressed a knowledge of handling peat slurries, a specific pump for peat slurries for a surface application was not available. It appeared that their expression of interest was largely based on experience in dredging applications, which apparently included handling peat or peat-like materials. Subsequently, IHC submitted a proposal, but most of the basic design concepts were derived from the information that Monenco had supplied earlier and lacked sufficient detail, and further discussions were discontinued. Discussions and correspondence continued with Toyo, the Japanese manufacturer, since the macerator design and the possible application of high pressure water jet equipment, included on the pump, appeared to be of considerable interest. Subsequently, Toyo submitted a proposal which was discussed and presented earlier to NRC.

In summary, although discussions were held with a number of pump manufacturers, and many novel ideas were put forward by the manufacturers, including various configurations of macerator and/or pump, only Allis-Chalmers offered to design and construct a model similiar to the previous Russian peat slurry pump. Other ideas and configurations were very interesting and should possibly be pursued, however, it was highly unlikely that any of the manufacturers could make any

warranty or would give an experienced opinion on performance of the unit in the field on peat slurry. It was anticipated that, for example, the Moyno or Toyo configurations would require extensive testing.

A cornerstone of the current peat slurry pumping program was the use of the previous Russian experience on which to build a base of knowledge. Although the peat slurry solids contents were of apparently low solid concentrations, from 2 to 5 or 6 percent, however, the methods were used in industrial practice for a number of years and proven successful in pumping peat slurries. It appeared wise to utilize the wealth of previous peat slurry pumping experience and information available to Monenco as a "stepping stone" in the development of successful wet mining method for Canadian conditions. It was reasoned that if the peat slurry pump/macerator, based on the previous USSR design, can be fabricated and demonstrated to perform satisfactorily in the field, then perhaps, along with the experience and knowledge developed, and in conjunction with the assistance of interested pump manufacturers, possible improved ways of handling, preparing, pumping and transporting peat slurries may be determined.

2.2 FINAL DESIGN SPECIFICATION FOR PEAT SLURRY PUMP

The original Monenco telex request for submission from the various pump manufacturers contained a performance specification for the peat slurry pump/macerator. At subsequent meetings with the preselected pump manufacturers, an information package was presented consisting of the details of the macerator configuration, propeller design (external propeller), and other mechanical components of the pump, including materials of construction. This formed the basis for further detailed discussions. The purpose of the performance specification route was to encourage innovative ideas from the various manufacturers, as opposed to complete replication of the previous model of

the USSR slurry pump. Only one manufacturer, namely Allis-Chalmers, submitted a proposal near to the performance specification. Two other manufacturers, Toyo and Robbins & Myers, submitted alternative proposals. The Allis-Chalmers proposal was recommended for a further detailed review by NRC, Monenco and the pump manufacturer regarding various aspects of their proposed design and method of fabrication. As a consequence of the review meeting, it was agreed to proceed with the Allis-Chalmers proposal and further details of pump construction and fabrication schedule were discussed.

In summary, the Allis-Chalmers proposal for construction of a peat slurry pump/macerator was accepted. It incorporated the following design features:

- o An enlarged inlet/macerator to reduce the tendency to plug;
- o Modification of the casing to allow a 14" connection to match the 14" diameter macerator;
- o The clearance between the impeller and side plate to be set initially at 1" to allow enough re-circulation to dislodge entrained air bubbles forming at the impeller eye;
- o A V-belt drive arrangement to allow vertical mounting of a standard O.D.P. 1800 rpm motor and a pump speed of approximately 1000 rpm. This arrangement would allow low cost modification of the pump speed which together with the pump clearance adjustment would permit a number of combinations of speed/clearance variations to experiment with increased solids concentrations;
- o The mechanical end consisted of a lower water lubricated bearing and an upper thrust bearing mounted on the floor plate;
- o Based on water performance, the pump would be expected to deliver 3000 USGPM (or 680 cubic metres per hour) at 85 foot head, requiring 107 h.p. At 100 feet of head it was estimated that a flow of 2100 USGPM (477 cubic metres per hour) requiring 96 h.p. would occur; and

- o The materials of construction were to be as follows: pump casing, cover and side plate of cast iron, impeller of stainless steel, column and floor plate of mild steel, deflector/macerator assembly of stainless steel CA6NM (275 BNH).

Based on the company's experience in the paper industry, Allis-Chalmers stated they did not consider that an air evacuation system would be required. Appendix C includes information on the cost for supplying the unit with motor and drive including the water test. The company stated that with the flexibility of the Allis-Chalmers design, field modifications could be made quickly and at minimum cost.

2.3 PUMP MANUFACTURING ASPECTS

Monenco approved the following drawings submitted by Allis-Chalmers:

- Sectional Layout 10 x 8 x 21 PW-V Pump, Proposal Drawing #98-X50-247 (Appendix C, Figure C-1);
- General Arrangement 14 x 8 x 21 PW-MV Pump, Drawing #98-433-151 (Appendix C, Figure C-2);
- Sectional Assembly 14 x 8 x 21 PW-MV Pump, Drawing #98-531-362 (Appendix C, Figure C-3);
- Plan View 14 x 8 x 21 PW-MV Pump, Drawing #98-X30-167 (Appendix C, Figure C-4);
- Section A-A 14 x 8 x 21 PW-M Pump, Drawing #98-X50-248, Sheet 1 of 2 (Appendix C, Figure C-5);
- View B-B 14 x 8 x 21 PW-M Pump, Drawing #98-X50-248, Sheet 2 of 2 (Appendix C, Figure C-6); and
- Assembly List 14 x 8 x 21 PW-MV Pump, Sheets 1, 2 and 3 (Appendix C, Figure C-7).

The General Arrangement Drawing (Appendix C, Figure C-2) had a lifting beam which was bolted to the cover plate by means of 2 "C" channels. An eye bolt could be adjusted to take account of variation in the centre of gravity. Figure C-2 showed a total weight of 6300 lbs. which included 1050 lbs. for the motor. However, the total weight was later reduced to 5800 lbs. by reducing the thickness of the cover plate and reinforcing it with a rib. Allis-Chalmers agreed to add 4 beams to the cover plate so that the assembly could be supported in the peat bog on pontoons, if necessary. The beams would extend 1 foot beyond the cover plate.

Drawings, see Figures C-5 and C-6, showed a spacer piece so that the clearance between the wear plate can be varied from 0.03 inch to 1.0 inch. Allis-Chalmers agreed to supply the spacer pieces. Also, Allis-Chalmers supplied several spacers so the clearance between the propeller and static knife could be increased from 2.5 inches to 4.5 inches. Allis-Chalmers also agreed to supply a 45° elbow with an 8 inch inlet and a 12 inch diameter outlet at the pump discharge.

PART 3. PUMP PERFORMANCE TESTS

3.1 PERFORMANCE TEST SPECIFICATIONS

Allis-Chalmers provided expected pump performance curves No. A-6536-2 and No. P-0001 (see Figures C-8 and C-9, Appendix C) for the peat slurry pump/macerator for standard and 1" clearance between impeller and wear plate, respectively. The curves were based on expected performance of the unit on water without the macerator/propeller assembly which was estimated would cause a loss of approximately 5% in efficiency for the aforementioned curves. Allis-Chalmers estimated in their modified proposal (August, 1984) that the peat slurry pump/macerator would deliver an estimated flow of 3000 USGPM at 85 ft. head and 2100 USGPM at 100 ft. head on water, at 1000 rpm at 1" clearance and using a 125 hp motor. It was planned to accept the peat slurry pump if the performance results varied within 10% of the curves presented by Allis-Chalmers on water, after carrying out the required electrical and mechanical inspection.

A total of five full performance tests were approved by Monenco. Each test was requested to be performed for one hour duration of pumping of clear water. The sequence of testing was to include the following:

a) 1000 rpm with a minimum clearance (0.03") between the impeller and the wear plate and 4.5" clearance between the propeller and the static knife, with water lubrication;

b) 1000 rpm with a maximum clearance (1") between the impeller and the wear plate and also 4.5" clearance between the propeller and the static knife, with water lubrication;

c) 800 rpm with a 1" clearance between the impeller and the wear plate and also 4.5" clearance between the propeller and the static knife, with water lubrication;

d) 600 rpm with a 1" clearance between the impeller and the wear plate and also 4.5" clearance between the propeller and the static knife, with water lubrication; and

e) 800 rpm of pump with a clearance 1" between the impeller and the wear plate with grease lubrication system and without the propeller.

The test data including the temperature of the thrust bearing and performance characteristics of pump for each test set up was required to be supplied by Allis-Chalmers. The following measurements, during each test, were requested to be made during one hour pumping operations at 600, 800 and 1000 rmp.

a) Flow rate

b) Dynamic head

c) Power input

d) Vibration level

e) Bearing temperature - upper, and

f) Efficiency

All of the tests were to be performed according to ASME testing procedures.

3.2 ACTUAL SHOP PERFORMANCE TESTS

The actual shop performance tests of the peat pump/macerator were carried out to determine its performance on water at 1000, 800 and 600 rpm. Tests were carried out with minimum wear plate clearance at 1000 rpm to determine the maximum head and horsepower absorbed by the pump. All other tests were carried out with the maximum 1" wear plate clearance to determine the minimum head and efficiency produced by the pump/macerator at these conditions. The stump deflector was removed during the last test to determine how much horsepower it absorbed.

321 TEST PROCEDURE

A total of five full performance tests, in accordance to ASME test procedure, were carried out. The following parameters were measured for each test.

a) Flow rate,

b) Total dynamic head,

c) Power input,

d) Pump efficiency, and

e) Temperature of the pump upper thrust bearing.

The above parameters were recorded over the full operating range at approximately 500 USGPM increments.

The five tests carried out were as follows:

Test #1

1000 rpm with a minimum clearance (0.03") between the impeller and the wear plate and 4.5" clearance between the propeller and the static knife.

Test #2

1000 rpm with a maximum clearance (1") between the impeller and the wear plate and also 4.5" clearance between the propeller and the static knife.

Test #3

800 rpm with a 1" clearance between the impeller and the wear plate and also 4.5" clearance between the propeller and the static knife.

Test #4

600 rpm with a 1" clearance between the impeller and the wear plate and also 4.5" clearance between the propeller and the static knife.

Test #5

800 rpm with a clearance of 1" between the impeller and the wear plate without the propeller.

All pumping tests were carried using only a clear water lubrication system for the bearings of the pump/macerator unit. Proposed tests using a grease lubrication system (Test #5) was ommitted in accordance with the minutes of the meeting dated January 22, 1985 (see Appendix G). It was decided that for this model of pump/macerator the 8 oz capacity of the spring-loaded grease cup may not be inadequate and that it would be converted to water lubrication

by simply connecting a water supply to the grease system. Allis-Chalmers estimated that the water lubrication system would require 2-3 USGPM of clean water.

Vibration readings were taken during Test #1 and were found to be relatively low.

322 OBSERVATIONS

Monenco's pump specialist attended performance testing of the peat slurry pump at Allis-Chalmers Cincinnati plant on May 30, 1985. A request to video tape the pump test was not granted by Allis-Chalmers.

The following points were noted at the start of the pump tests. At low flow or no flow, the pump was drawing 150 to 160 hp, which was not expected. It was also noted that the sump level was drawn down excessively by the pump and that air entered the pump. However, it was noted that the pump operated under the severe conditions without any difficulty. After half an hour of operation, it was decided to stop the test and modify the suction piping so that more water could flow into the sump and thus avoid the sump being sucked dry.

The pump was restarted, after the return piping to the sump was changed. The test again was not successful. After one half hour of operation, the belts started to smoke. It was decided to tighten the belt in accordance with normal procedures. Allis-Chalmers used a special belt tightening gauge to ensure that the belts were properly tightened. It was also noted during the test, that the drain connection from the pump support column to allow the seal water to drain from the pump column, seemed to be too small. The water coming out of the connection seemed to be under pressure and it was feared that, if

the column was pressurized, water would enter the pump thrust column and possibly damage the anti-friction, oil-lubricated bearing. It was decided to remove the inspection cover on the pump column so that no buildup of pressure in the column could occur.

The pump was restarted with all deficiencies corrected and no difficulties were encountered in completing Test No. 1. It was noted that the horsepower readings were still high and ranged from 150 hp at shutoff to over 200 hp at maximum flow. It was dicided that the modified return piping to the sump was still too small, and it was increased to 14 inches.

For Test No. 2, the clearances were increased from the nominal .030 inch to a maximum 1 inch. The 14 inch return lines to the sump were installed, and the second test was started. It was decided that, due to the good vibration test reading results for Test No. 1 being recorded at 1000 rpm, and having likely the highest rated hp consumption and consequently the highest vibration reading, that no further vibration readings would be taken in order to ensure that as many pumping tests as possible could be carried out during the allotted test period.

For Test No. 3 operating at 600 rpm, the pump pulley was changed and the test was started and witnessed. It was felt that due to the positive test results for units 1 and 2 further witnessing of the tests would not be required. Furthermore, final further testing was deferred by Allis-Chalmers for several days due to shop scheduling reasons.

323 TEST RESULTS

1. The water performance tests confirmed that the peat slurry pump/macerator was manufactured in accordance with the basic design specification, provided by Monenco.

2. The water performance tests also demonstrated that the pump/macerator was fabricated to meet requirements and no serious deficiencies or difficulties were encountered which were not readily remedied, during testing.

3. Figures D-1 to D-17 (Appendix D) display the pumping test data as provided by Allis-Chalmers.

4. Based on Allis-Chalmers' previous experience in the paper industry, Allis-Chalmers predicted that the pump with a 1" clearance at 1000 rpm (without the macerator/deflector assembly) would deliver approximately 3000 USGPM at 85 ft. of head and require 107 Bhp. At 100 ft. head Allis-Chalmers also previously estimated a flow of 2100 USGPM and a Bhp of 96 hp (see Allis-Chalmers proposal-letters, Appendix C).

5. The two tests at 1000 rpm were carried out as follows:

   - Test No. 1 with a minimum clearance (0.03") between the impeller and the wear plate with water lubrication, and

   - Test No. 2 with a maximum clearance (1") between the impeller and the wear plate with water lubrication.

The results of the comparison of the pump performance characteristics predicted by Allis-Chalmers in their proposal, versus the actual shop performance test results on water (see Figures 3-1 and 3-2) are as follows:

a) At 1" clearance and 1000 rpm the pump delivered approximately 2650 USGPM, at a 70 ft. head and requiring 140 Bhp. The pump efficiency was 33.7% (Figure 3-2). The 70 ft. head was lower than the expected 75 ft. head and only a flow of 1240 USGPM was obtained at 100 ft. of head, instead of the estimated flow of 2100 USGPM.

b) At 0.03" clearance and 1000 rpm the pump delivered approximately 4000 USGPM at a 117 ft. head and 200 Bhp, when the pump efficiency was a maximum or equal to 60% (see Figure 3-1). At 100 ft. head, a flow rate of approximately 4600 USGPM was obtained. This pump capacity was two times greater than Allis-Chalmers estimated for the pump with a 1" clearance and operating against 100 ft. of head.

c) The test performance characteristics for the pump operating at 800 rpm and 600 rpm with a 1" clearance (Figures 3-3 and 3-4) showed that the head produced by the pump was lower than expected. This may be due to the head loss for the stump deflector and macerator not being proportional to the square of the speed, which is the case for the head produced by the pump/macerator alone resulting in the macerator loss becoming a larger percentage of the total head produced by the pump.

d) Figure 3-5 shows that the head decreased from 25.1 ft. to 23 ft. or by 8.6% when the stump deflector was removed.

e) Plotting the velocity vibration readings on the General Machinery Severity Chart, Figure 3-6, indicated that there were no basic mechanical dynamic deficiencies and the majority of the readings were in the good and very good range, and with one reading at low flow in the fair range which could be expected at the low flow of 546 USGPM. Some readings at other flows were even in the extremely smooth range.

f) Based on the water performance testing on the peat slurry pump/macerator, Monenco accepted the unit for further field trials on peat slurry.

Appendix F includes Allis-Chalmers' Instruction Manual for installation, operation and maintenance of the peat slurry macerating pump. Appendix G includes 17 photos from the peat slurry pump/macerator shop tests.

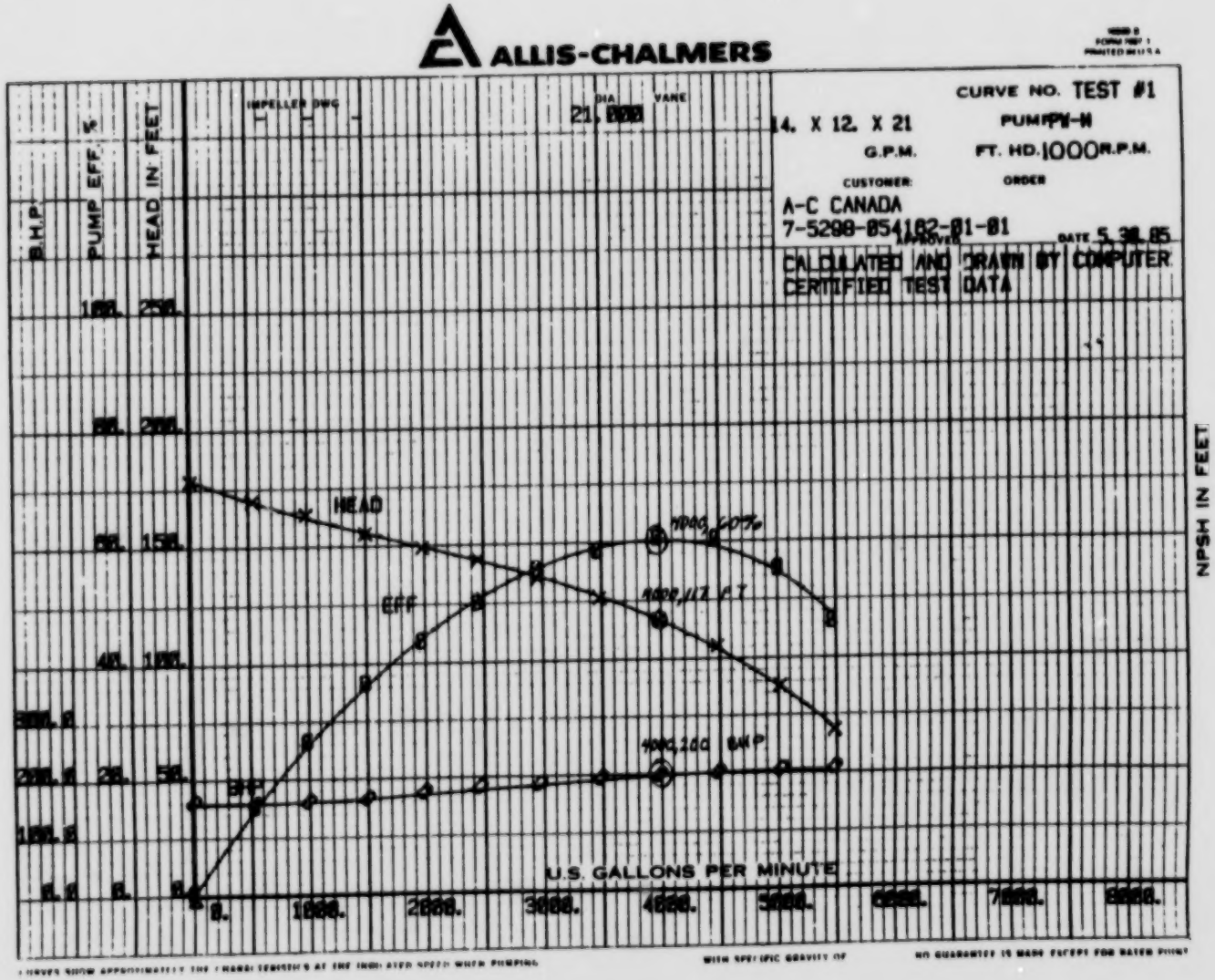


FIGURE 3-1. CALCULATED AND DRAWN BY COMPUTER CERTIFIED TEST NO. 1 DATA.

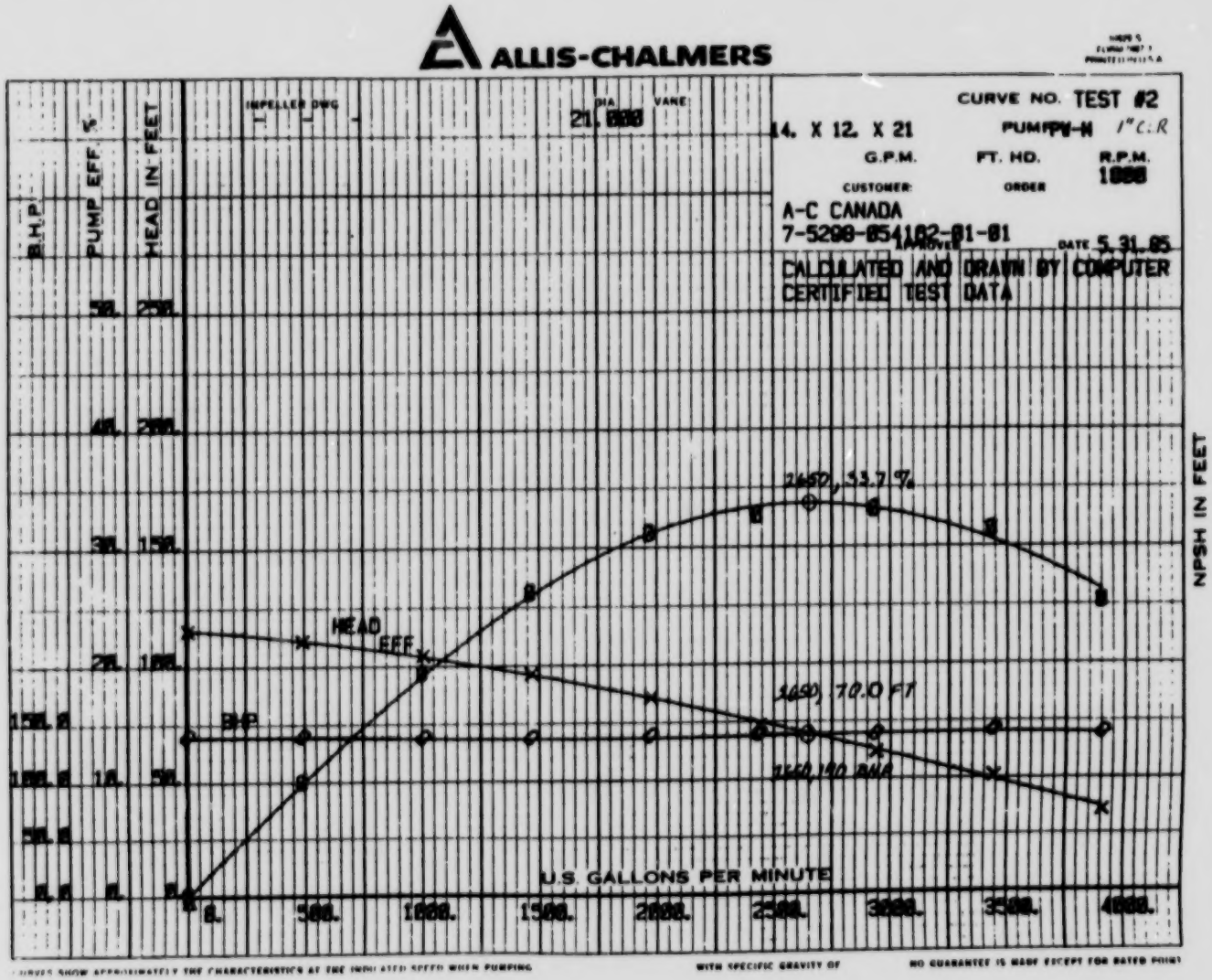


FIGURE 3-2. CALCULATED AND DRAWN BY COMPUTER CERTIFIED TEST NO. 2 DATA.

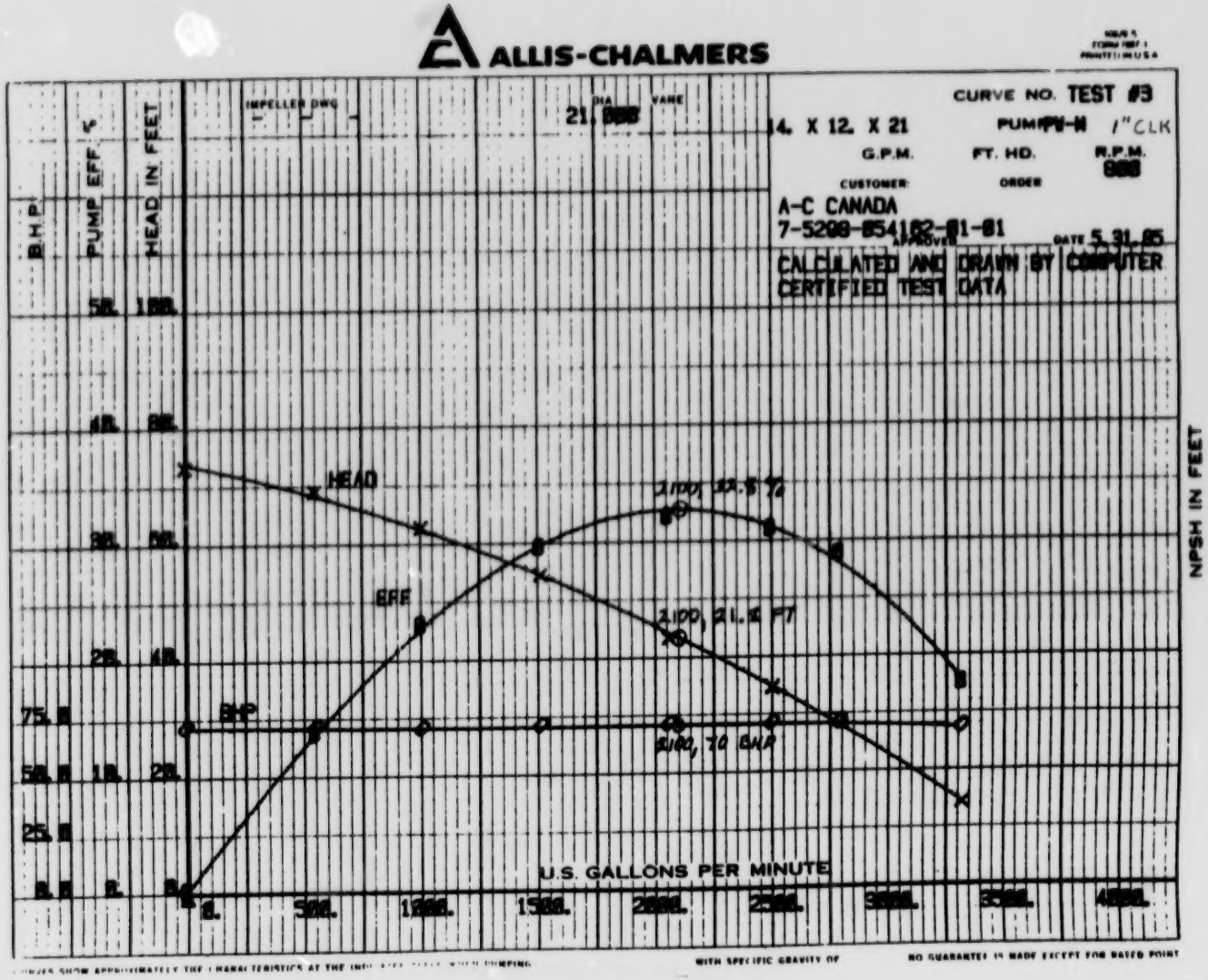


FIGURE 3-3. CALCULATED AND DRAWN BY COMPUTER CERTIFIED TEST NO. 3 DATA.

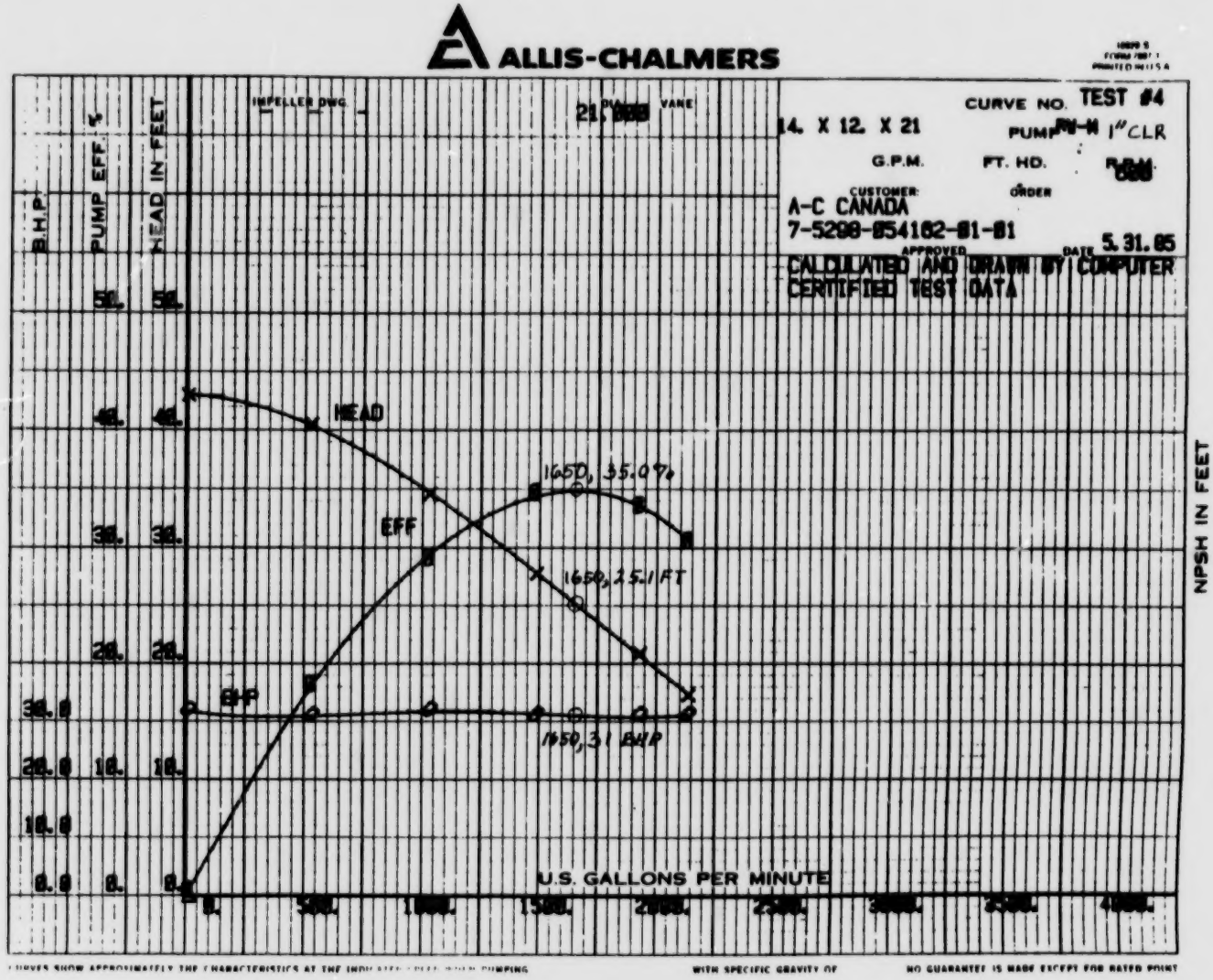


FIGURE 3-4. CALCULATED AND DRAWN BY COMPUTER CERTIFIED TEST NO. 4 DATA.

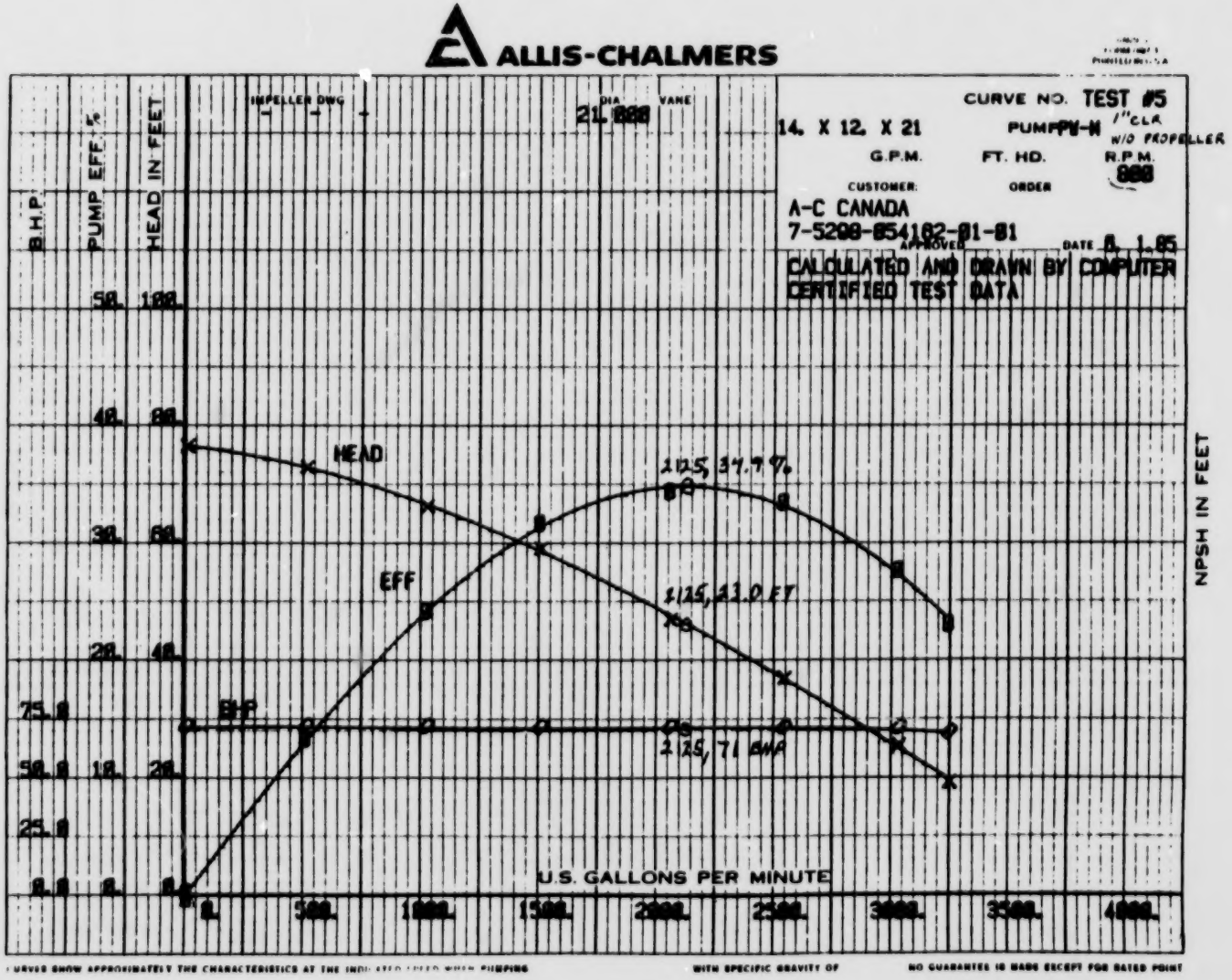
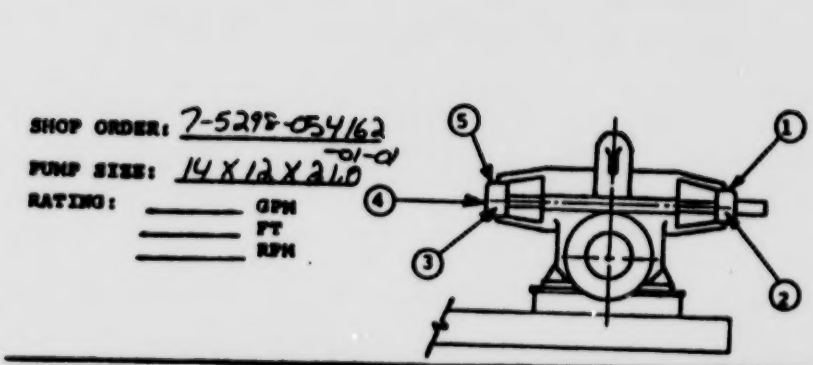
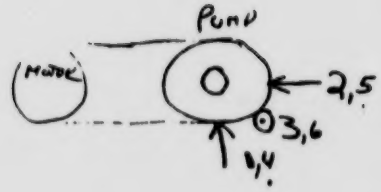


FIGURE 3-5. CALCULATED AND DRAWN BY COMPUTER CERTIFIED TEST NO. 5 DATA.





TESTED BY: TFH

DATE: 5-30-85

VIBRATION READINGS

FLOWRATE	0 GPM		546 GPM		1011 GPM		1521 GPM		2021 GPM		2493 GPM		3011 GPM		3530 GPM	
IRD POSITION	FILTERED @ 1025 RPM	UNFILTERED	FILTERED @ 1025 RPM	UNFILTERED	FILTERED @ 1024 RPM	UNFILTERED	FILTERED @ 1034 RPM	UNFILTERED	FILTERED @ 1024 RPM	UNFILTERED	FILTERED @ 1019 RPM	UNFILTERED	FILTERED @ 1019 RPM	UNFILTERED	FILTERED @ 1027 RPM	UNFILTERED
1	.025	.14	.003	.005	.003	.005	(.025) .003	.005	(.025) .003	.005	(.025) .01	.05	(.025) .008	.04	(.025) .02	.13
2	.035	.35	.10	.375	.03	.35	.003	.005	.05	.28	.015	.25	.04	.2	.003	.005
3	.003	.005	.003	.005	.003	.005	.01	.18	.003	.005	.02	.15	.01	.14	.01	.12
4	.45	3	.003	.005	.003	.005	.003	.005	.003	.005	.20	.35	.14	.165	.38	1.6
5	.23	3	1.2	2.7	.5	2.5	.003	.005	.9	1.8	.25	1.8	.8	1.6	.003	.005
6	.025	.115	.003	.005	.003	.005	.005	2.0	.003	.005	.5	2.2	.2	2.0	.16	1.6

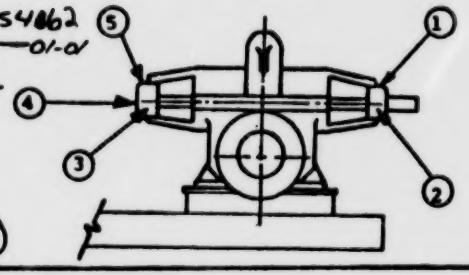
TEST 1

FIGURE 3-6. GENERAL MACHINERY VIBRATION SEVERITY CHART.

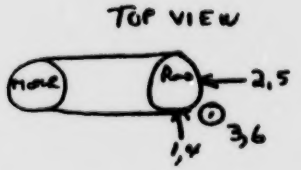
SHOP ORDER: 7-5298-054862 01-01

PUMP SIZE: 14 X 12 X 21

RATING: _____ GPM
_____ FT
_____ RPM



CANADA (ALLIS-CHALMERS)



TESTED BY: TFH

DATE: 5-30-85

VIBRATION READINGS

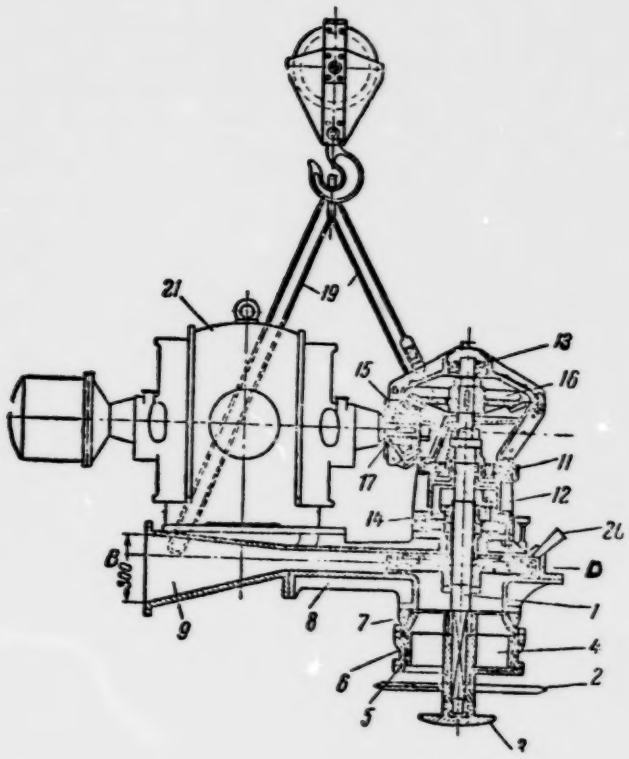
FLOWRATE	4044 GPM		4542 GPM		5074 GPM		5554 GPM		___ GPM		___ GPM		___ GPM		___ GPM	
IRD POSITION	FILTERED @ 1076 RPM	UNFILTERED	FILTERED @ 1215 RPM	UNFILTERED	FILTERED @ 1014 RPM	UNFILTERED	FILTERED @ 1013 RPM	UNFILTERED	FILTERED @ RPM	UNFILTERED	FILTERED @ RPM	UNFILTERED	FILTERED @ RPM	UNFILTERED	FILTERED @ RPM	UNFILTERED
1	(625) .02	.12	(625) .003	.005	(625) .007	.005	(625) .003	.005								
2	.045	.20	.003	.005	.035	.20	.035	.18								
3	.015	.08	.003	.005	.007	.005	.003	.005								
4	.35	.80	.003	.005	.007	.005	.007	.005								
5	.69	1.8	.003	.025	.4	2.0	.4	1.8								
6	.55	1.0	.003	.005	.007	.005	.007	.005								

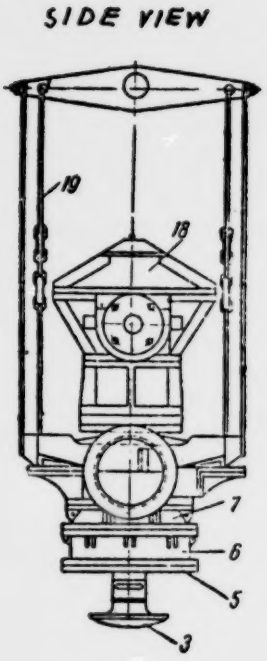
TEST 1

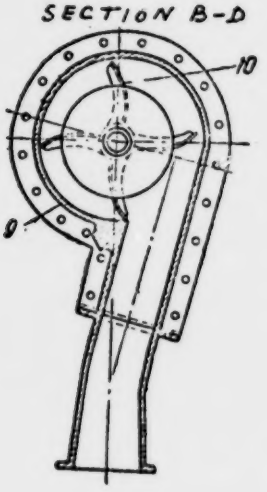
FIGURE 3-6. (Concluded)

APPENDIX A

Information on Previous USSR Peat Slurry Pump



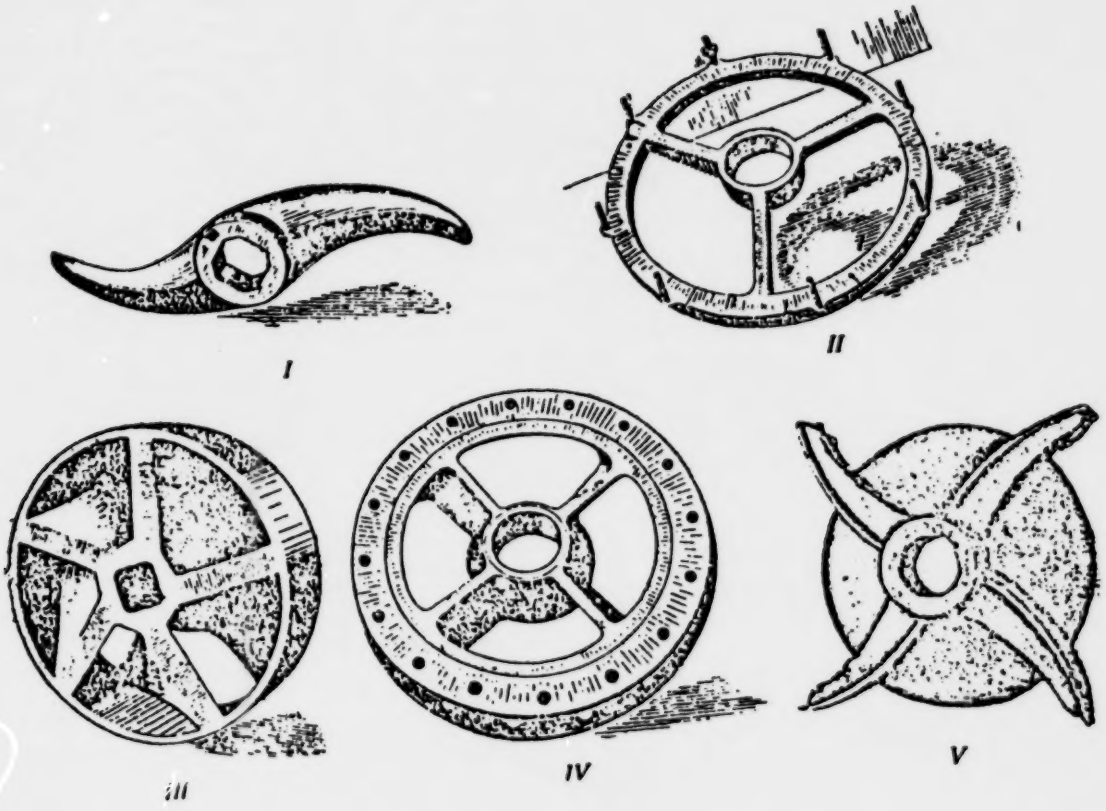




1- Drive Shaft - 410 RPM; 2 - Stump Deflector;
3- Nut; 4-Axial Wheel; 5- Static Knife;
6- Axial Wheel Casing; 7- Forwarding Guide;
8,9- Split Casing; 10- Impeller;
18- Reduction Gear; 21- Electric Motor -
65 kW and 730 RPM.

FIGURE A-1. The 1926 NEW STANDARD MODEL PEAT SLURRY PUMP

SOURCE: (4)



I-Stump Deflector; II- Static Knife; III- Axial Wheel;
IV- Forwarding Guide; V - Impeller.

FIGURE A-2. DETAILS OF THE LOWER SECTION OF THE 1926 MODEL PEAT SLURRY PUMP (NEW STANDARD SYSTEM)

SCALE (3)

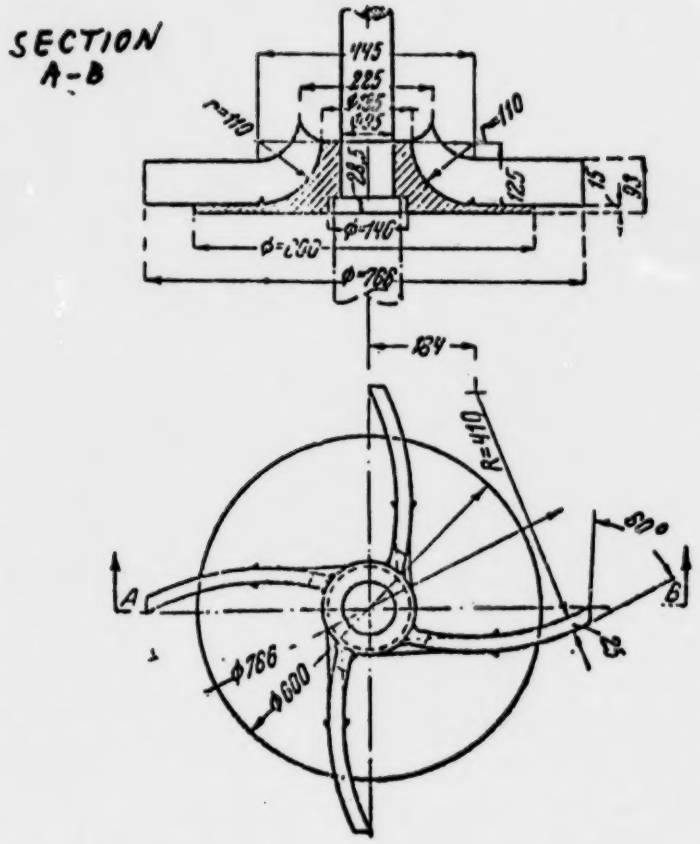
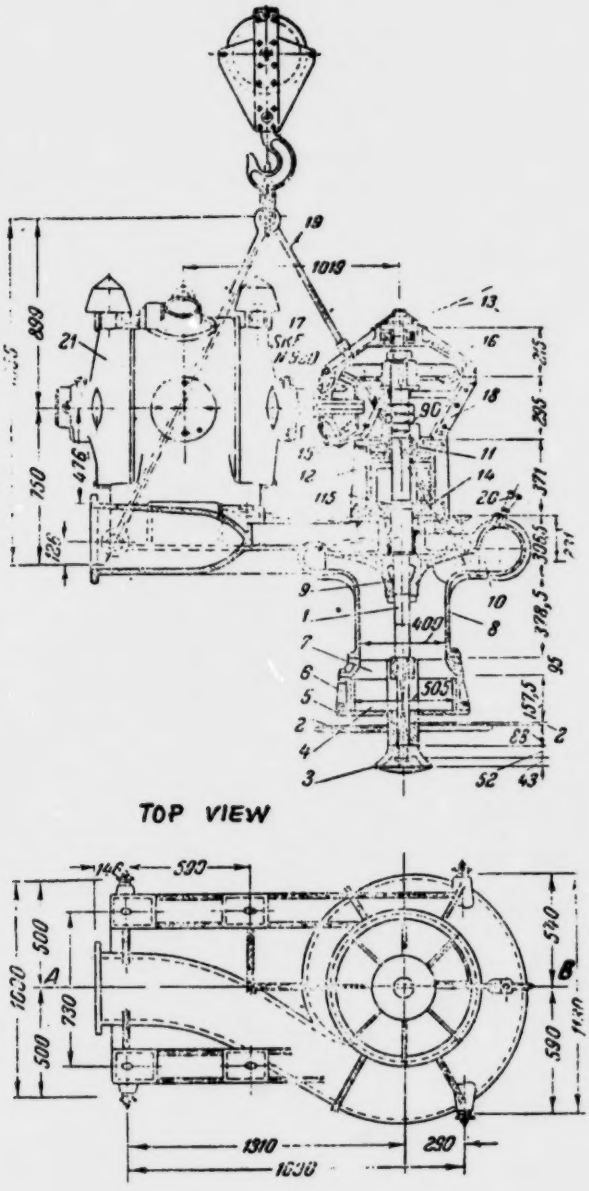


FIGURE A-3. REVISED IMPELLER DESIGN FOR THE 1926 MODEL PEAT SLURRY PUMP

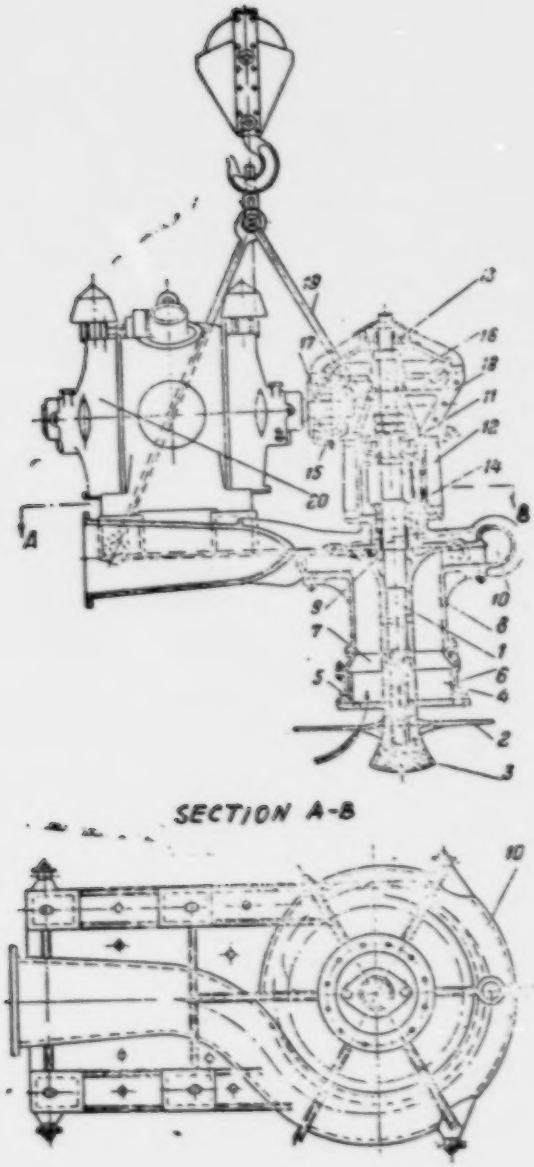
SOURCE: (4)



1- Drive Shaft - 365 RPM; Parts 2 to 7 same as 1926 Model (Fig. A-1);
8- Casing; 9- Modified Impeller; 10- Casing with Voluted Chamber;
21- Electric Motor - 55 kW, 730 RPM.

FIGURE A-4. THE 1929 MODEL PEAT SLURRY PUMP (NEW STANDARD)

SOURCE: (4)



1- Drive Shaft-365 RPM; 2- Double Curvature Stump Deflector Blade; 6- Axial Wheel Casing; 8- Casing; 9- Impeller; 10- Casing with Voluted Chamber; 20- Electric Motor - 65 kW, 730 RPM; Other part numbers are similar to those on the 1926 Model (Fig. A-1).

FIGURE A-5. THE 1933 MODEL PEAT SLURRY PUMP, (NEW STANDARD)

SOURCE: (4)

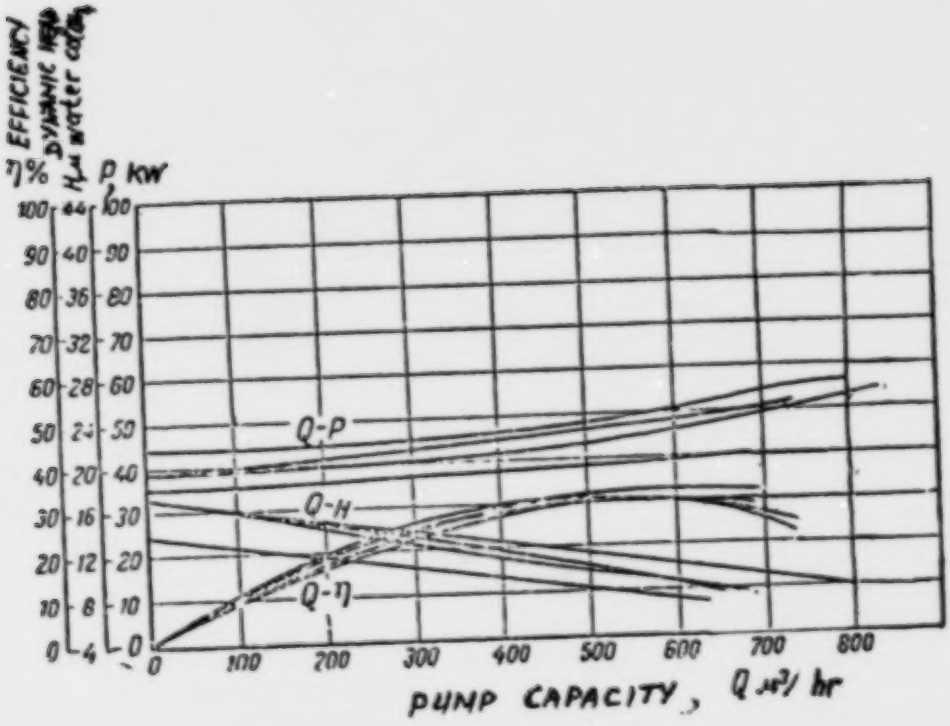


FIGURE A-6. COMPARISON OF THE PUMP CHARACTERISTICS OF VARIOUS 1926 MODEL SLURRY PUMPS AT A PEAT SLURRY VISCOSITY OF 6.5 POISE.

SOURCE: (4)

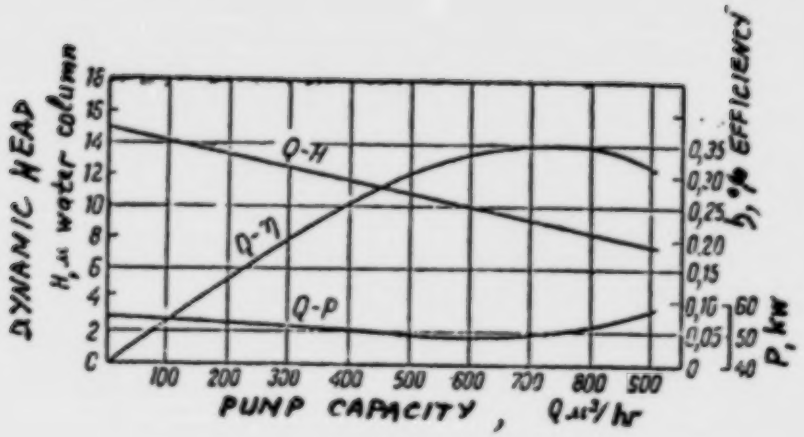


FIGURE A-7. PUMP CHARACTERISTICS OF THE 1929 MODEL PEAT SLURRY PUMP (INDUSTRIAL TEST, 1939).

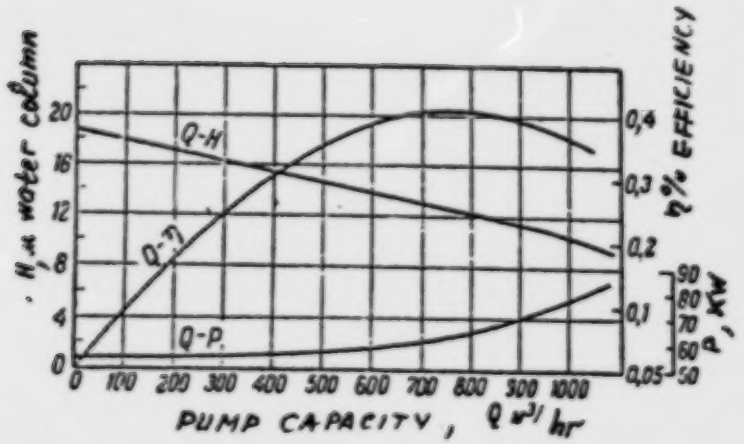
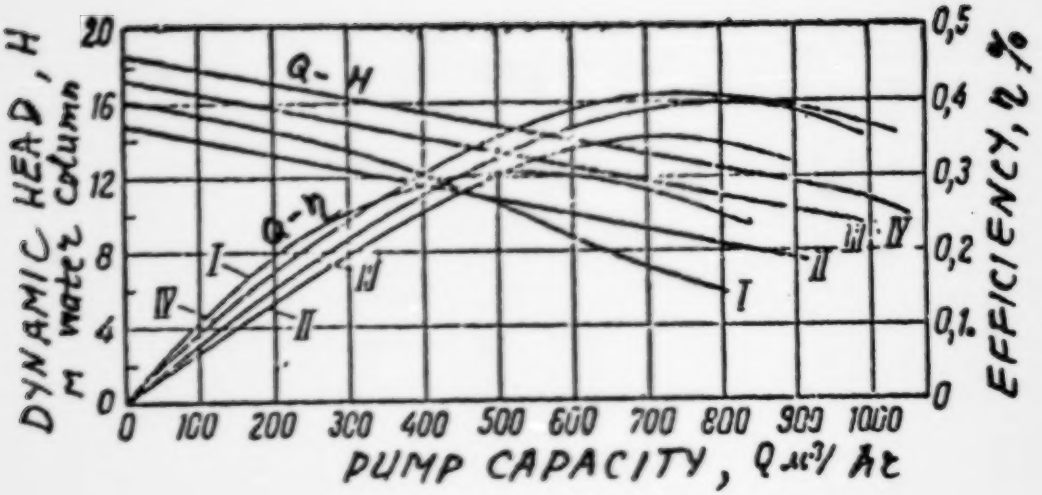


FIGURE A-8. PUMP CHARACTERISTICS OF THE 1933 MODEL PEAT SLURRY PUMP (INDUSTRIAL TEST, 1939).

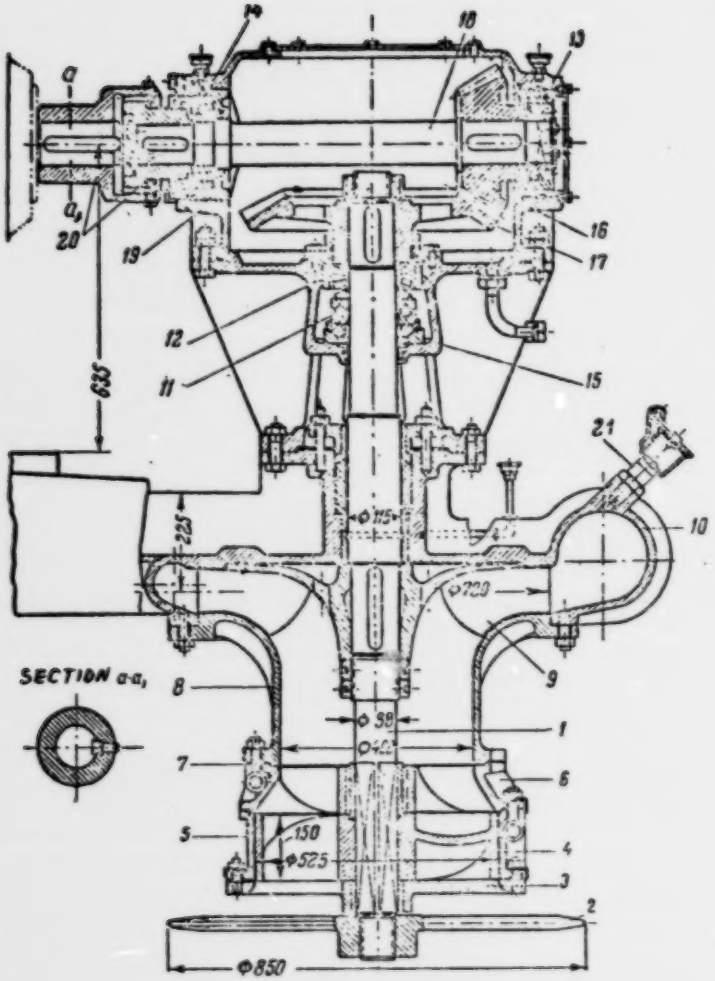
SOURCE: (4)



I - The 1926 Model Peat Slurry Pump (New Standard)
II - The 1929 Model Peat Slurry Pump (New Standard)
III - The 1933 Model Peat Slurry Pump (New Standard)
IV - The 1938 Model Peat Slurry Pump (New Standard)

FIGURE A-9. COMPARISON OF THE CHARACTERISTICS OF VARIOUS PEAT SLURRY PUMPS. (INDUSTRIAL TESTS 1939)

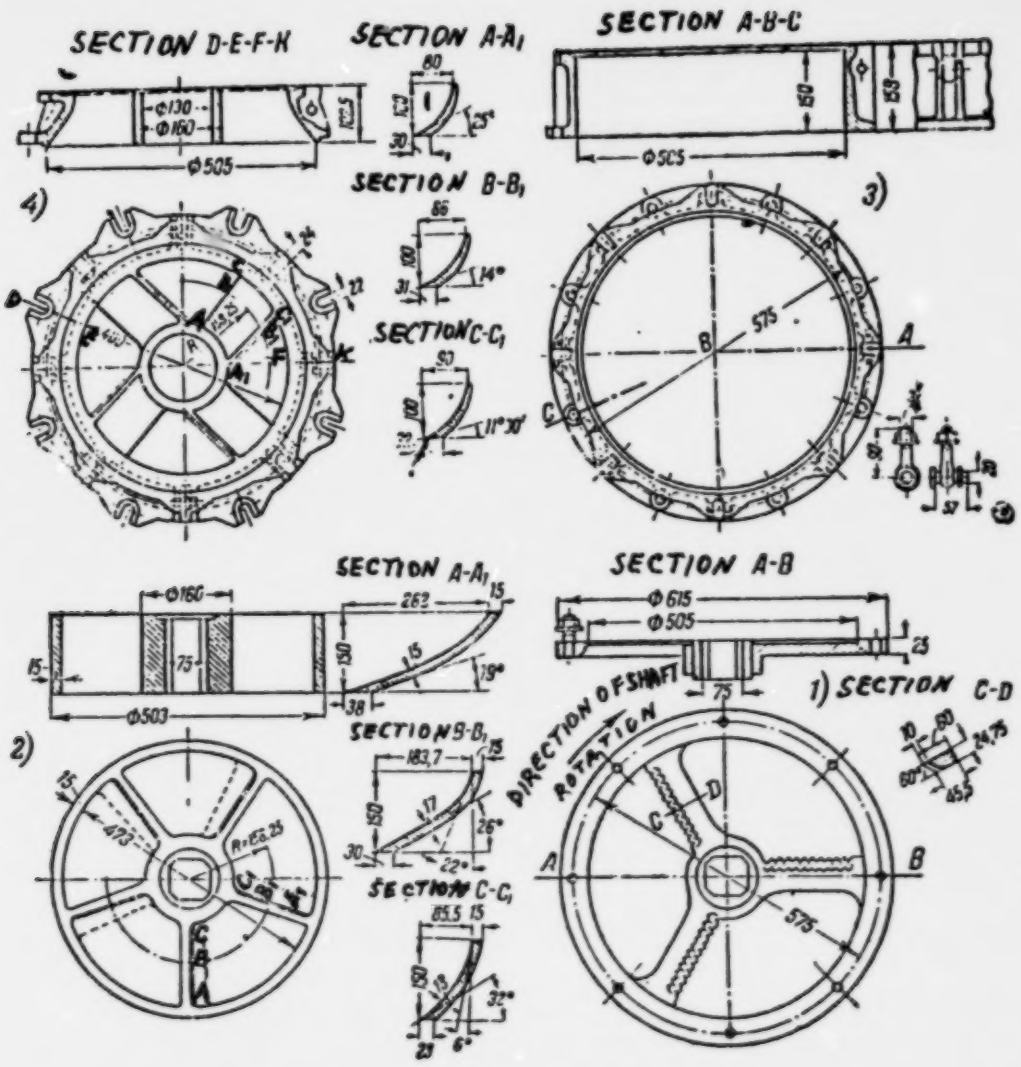
SOURCE: (4)



1- Drive Shaft-414 RPM; 2- Double-Bladed Stump Deflector;
3- Static Knife; 4- Axial Wheel; 5- Axial Wheel Casing;
6- Forwarding Guide; 7- Clamp Bolt; 8- Casing; 9- Impeller;
10- Casing with Voluted Chamber; 21- Air Evacuator.

FIGURE A-10. THE 1939 MODEL PEAT SLURRY PUMP (NEW STANDARD SYSTEM).

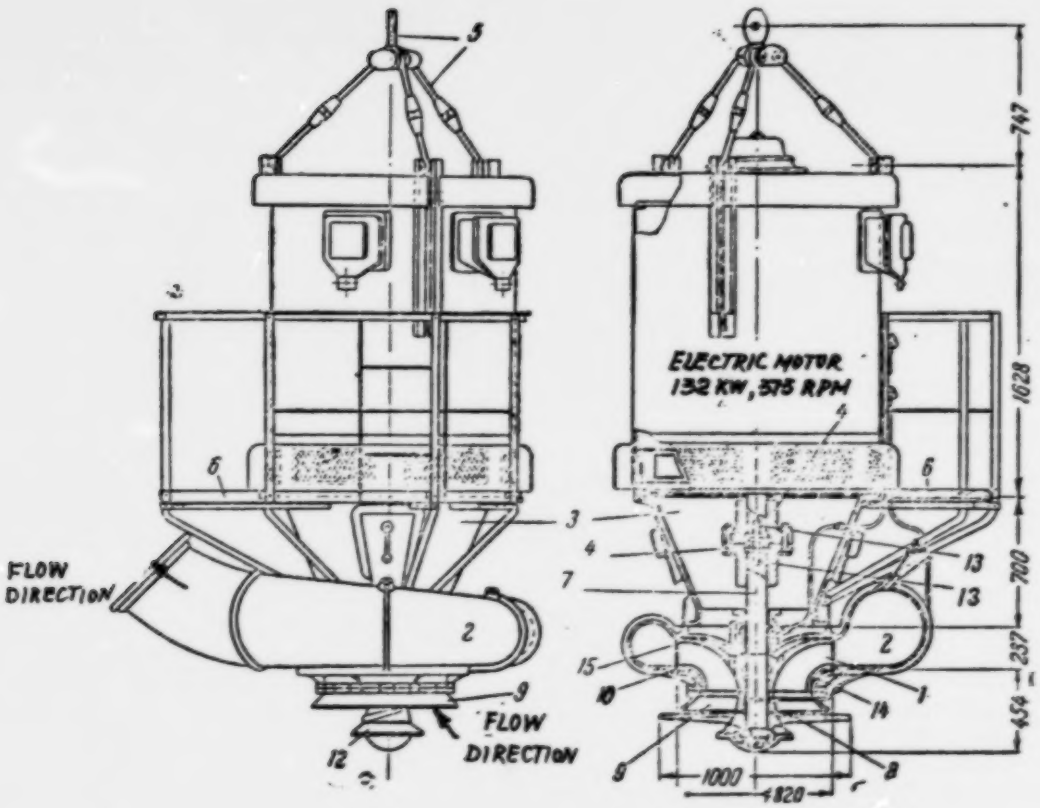
SOURCE: (4)



1 - Static Knife; 2 - Axial Wheel; 3 - Axial Wheel Casing;
4 - Forwarding Guide.

FIGURE A-11. DETAILS OF THE LOWER SECTIONS OF THE 1926, 1929, 1933 AND 1938 MODEL PEAT SLURRY PUMPS (NEW STANDARD SYSTEM).

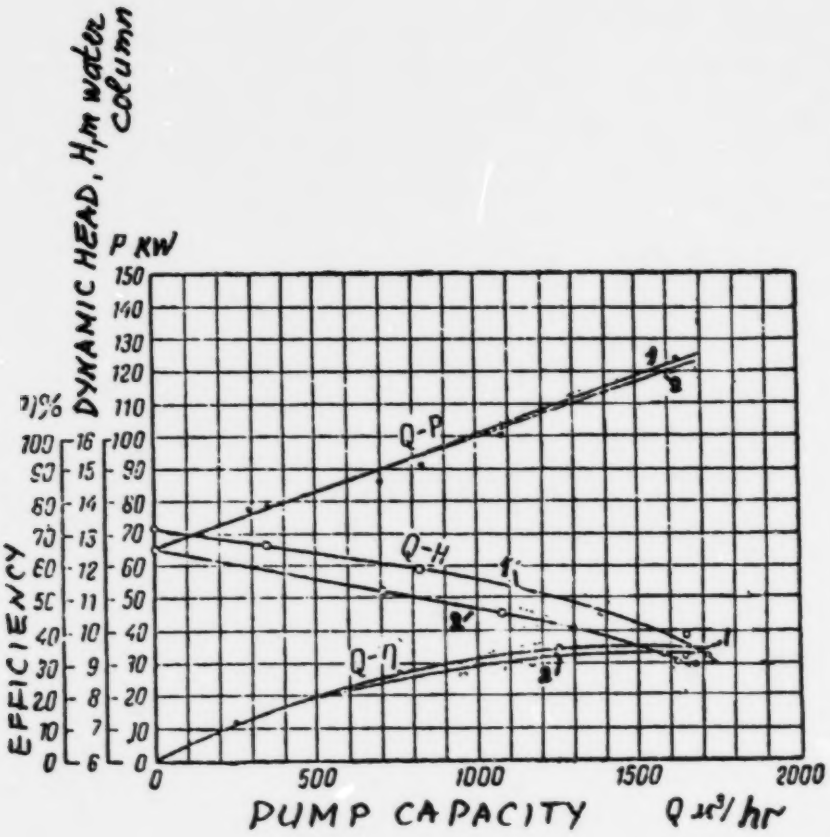
SOURCE: (4)



1- Impeller; 2- Casing with Voluted Chamber; 3- Transition Chamber;
4- Rigid Coupling; 5- Three-Point Suspension; 6- Service Platform;
7- Drive Shaft; 8- Stump Deflector; 9- Cone Shaped Static Knife Plate;
10- Impeller Casing.

FIGURE A-12. THE 1931 MODEL PEAT SLURRY PUMP (SUPER STANDARD SYSTEM).

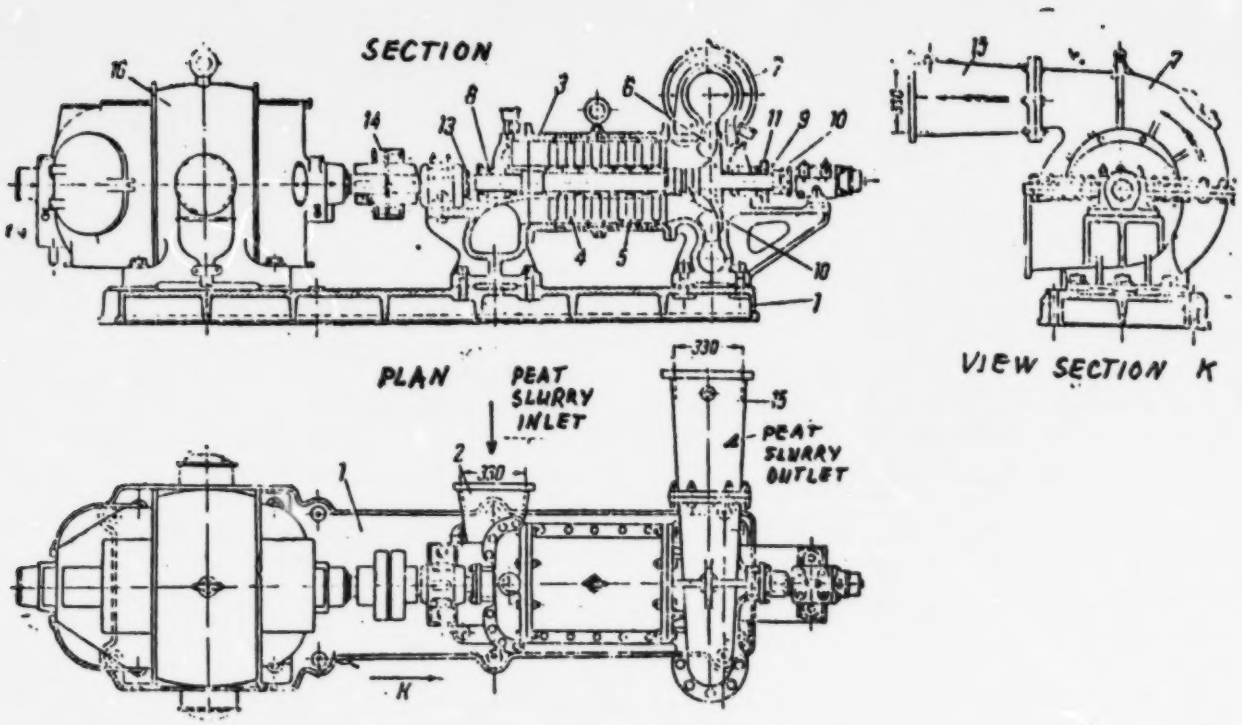
SOURCE: (4)



Curves are shown as follows:
1- stump deflector with a roll formed section;
2- stump deflector with a flat surface contour.

FIGURE A-13. PUMP CHARACTERISTICS OF THE 1928 MODEL PEAT SLURRY PUMP WITH DIFFERENT STUMP DEFLECTOR DESIGNS (INDUSTRIAL TEST,1938, SUPER STANDARD SYSTEM).

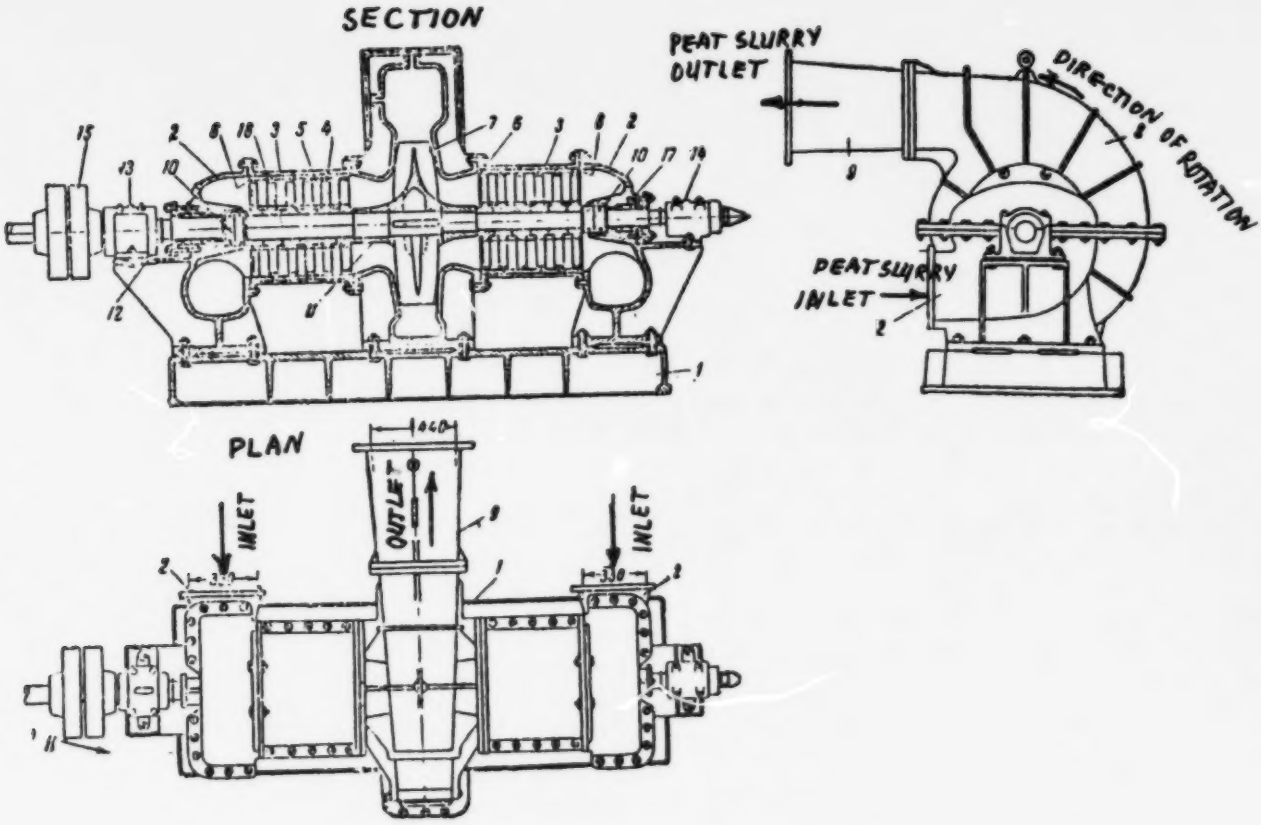
SOURCE: (4)



1- Baseplate; 2- Inlet; 3- Knife Casing; 4- Rotating Knives;
5- Static Knives; 6- Impeller; 7- Casing with Voluted Chamber;
16- Electric Motor-100 hp, 580 RPM.

FIGURE A-14. THE 1929 MODEL PEAT SLURRY PUMP/MACERATOR (NEW STANDARD SYSTEM).

SOURCE: (4)



1- Baseplate; 2- Inlets; 3- Knife Casing; 4- Rotating Knives; 5- Static Knives; 6- Flange; 7- Impeller; 8- Casing with Voluted Chamber; 9- Outlet Diffuser.

FIGURE A-15. THE 1930 MODEL PEAT SLURRY PUMP/MACERATOR (SUPER STANDARD SYSTEM).

SOURCE: (4)

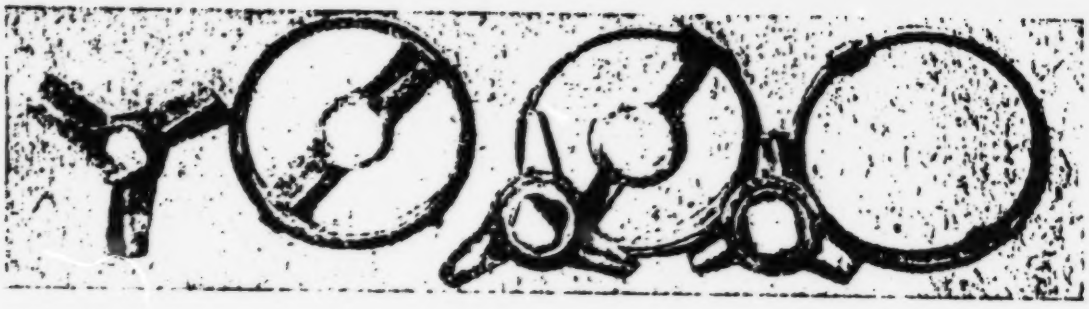
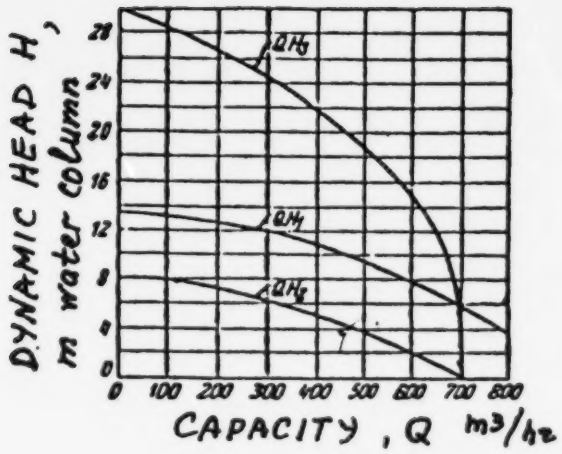


FIGURE A-16. STATIC AND ROTATING KNIVES OF A PEAT SLURRY PUMP/MACERATOR.

SOURCE: (3)



Curves are shown as follows:

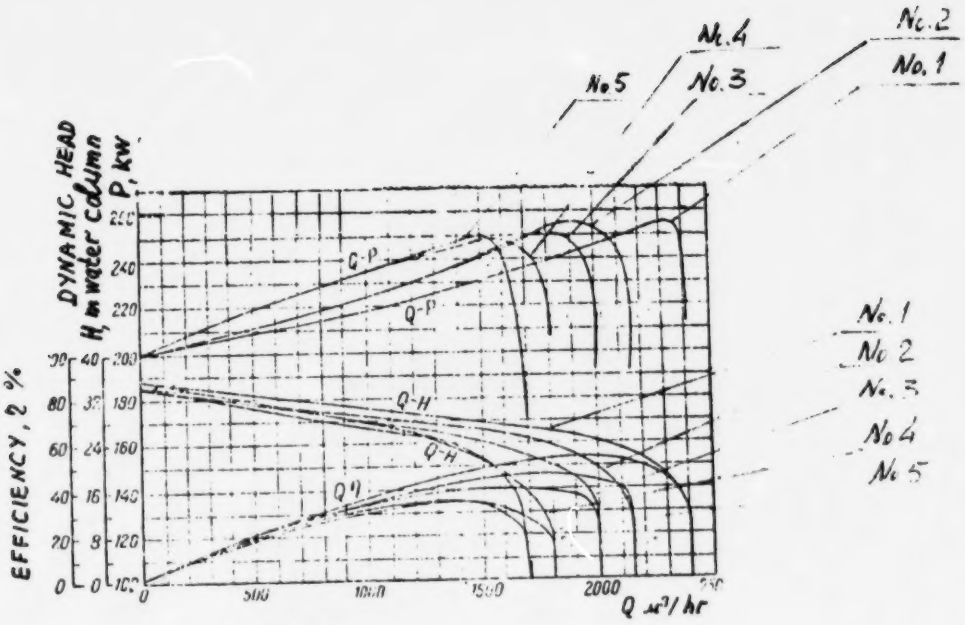
a) $Q-H_1$, peat slurry pump pressure as measured at the pump outlet;

b) $Q-H_2$, peat slurry pump pressure as measured at the pump/macerator inlet when operating at a mining pit depth of 3 meters;

c) $Q-H_3$, peat slurry pump/macerator pressure as measured at the pump/macerator outlet.

FIGURE A-17. COMPARISON OF THE PUMP CHARACTERISTICS OF A 1926 MODEL PUMP AND PEAT SLURRY PUMP AND PUMP/MACERATOR SYSTEM.

SOURCE: (3)



CAPACITY OF
PUMP/MACERATOR SYSTEM

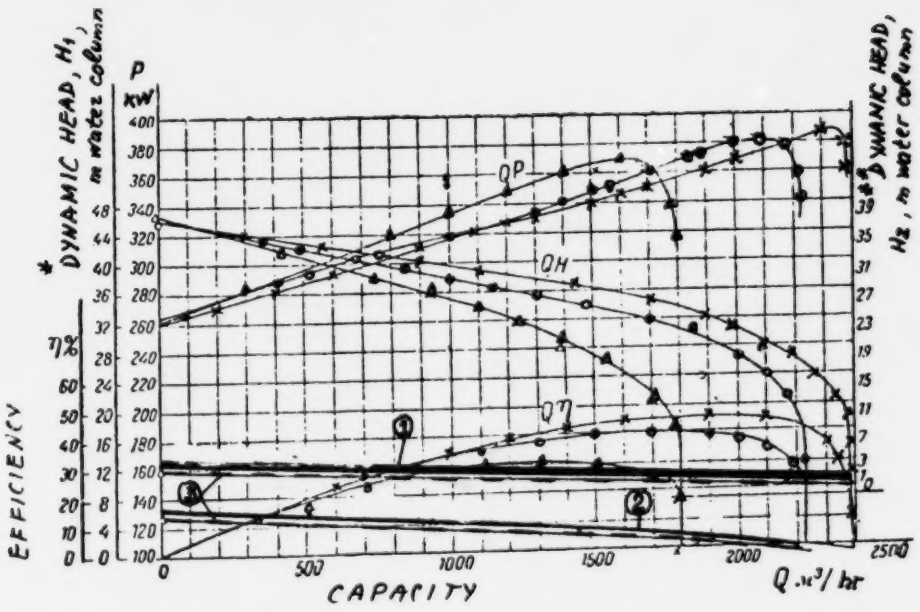
Curves are shown as follows:

No. 1, water;
No. 2, peat slurry with a 2.8% solids content and a viscosity of 2.2 Poise;
No. 3, peat slurry with a 3.0% solids content and a viscostiy of 4.5 Poise;
No. 4, peat slurry with a 3.5% solids content and a viscosity of 8.8 Poise;
No. 5, peat slurry with a 3.6% solids content and a viscosity of 10.2 Poise.

Note: The pump/macerator is located separately, 15 meters beyond the discharge port of the slurry pump.

FIGURE A-18. COMPARISON OF THE CHARACTERISTICS OF THE 1930 MODEL PEAT SLURRY PUMP AND PUMP/MACERATOR SYSTEM (SUPER STANDARD SYSTEM, INDUSTRIAL TEST, 1938) WITH VARIOUS PEAT SLURRY SOLIDS CONCENTRATION.

SOURCE: (4)



Curves shown as follows:

-x-x-x-x- curves represent the case for water;
-o-o-o-o- curves represent the case for a peat slurry of 2.25% solids content and a viscosity of 1.7 Poise;
-Δ-Δ-Δ-Δ- curves represent the case for a peat slurry of 3.5% solids content and a viscosity of 9.8 Poise.

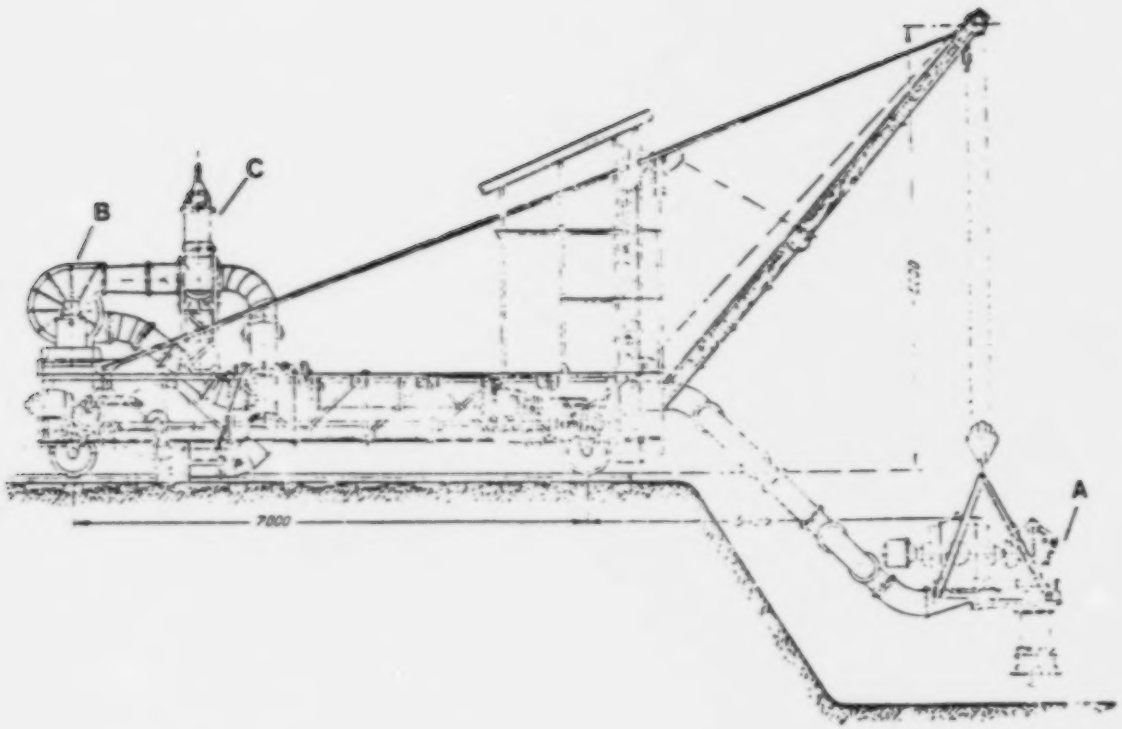
Separate curves are also shown, as follows:

Line No. 1 shows the pressure beyond the outlet of the peat slurry pump;
Line No. 2 shows the pressure before the inlet of the macerator (the peat slurry macerator is located separately after the peat slurry pump, see Fig. 1-19);
Line No. 3 shows the same as Lines No. 1 and 2 but only for water.

Note: *Dynamic head, H_1, is measured at the level of the peat slurry in the mining pit;
**Dynamic head, H_2, is measured at the outlet of macerator.

FIGURE A-19. COMPARISON OF THE CHARACTERISTICS OF THE 1928 MODEL PEAT SLURRY PUMP AND PUMP/MACERATOR SYSTEM (SUPER STANDARD, INDUSTRIAL TEST, 1938)

SOURCE: (4)

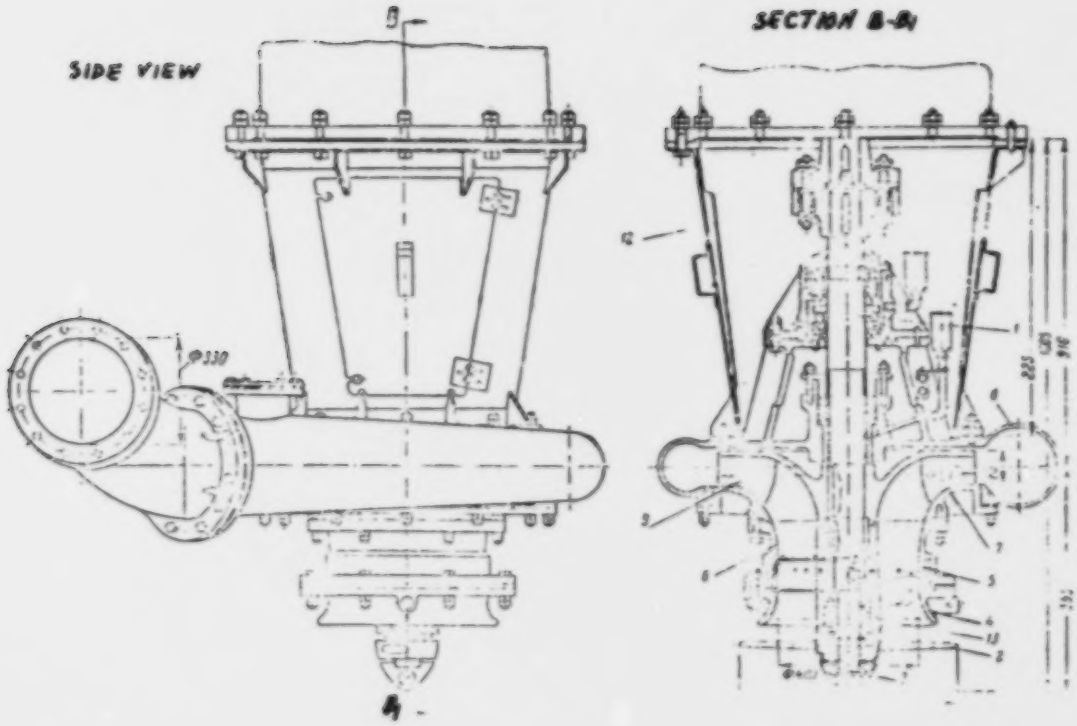


A - The Peat Slurry Pump
B - The Peat Slurry Pump/Macerator
C - The Air Evacuator

Note: The Peat Slurry Pump/Macerator unit (B) was situated approximately 15 m beyond the outlet (A) of the 1926, 1929, 1933, 1938 Slurry Pump Models for New Standard System and approximately 12 m beyond the outlet of the 1928, 1931 Slurry Pump Models for Super Standard Syst.

FIGURE A-20. GENERAL ARRANGEMENT OF THE PEAT SLURRY PUMP AND PUMP MACERATOR SYSTEM.

SOURCE: (3)

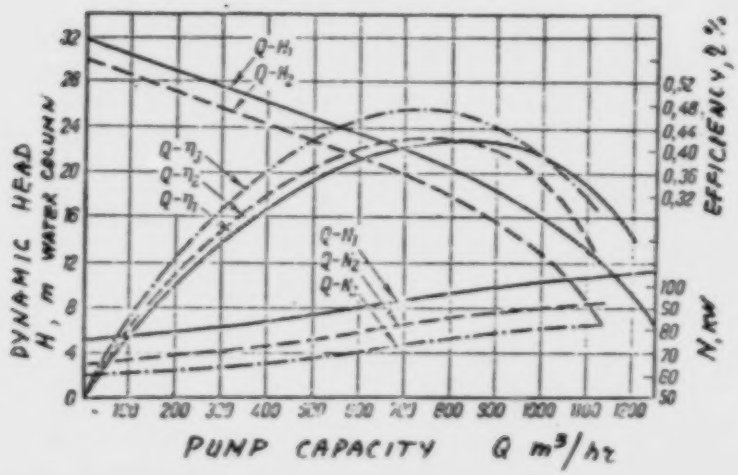


1- Drive Shaft (Direct Drive Electric Motor-80 kW, 580 RPM); 2- Double Bladed Stump Deflector; 3- Nut; 4- Static Knife; 5- Axial Wheel; 6- Axial Wheel Casing and Forwarding Guide; 7- Impeller Casing; 8- Casing with Voluted Chamber; 9- Impeller.

Note: The Peat Slurry Pump pumps the peat slurry directly to the receiver.

FIGURE A-49 [illegible] PEAT SLURRY PUMP (MPA [illegible])

SOURCE: [illegible]

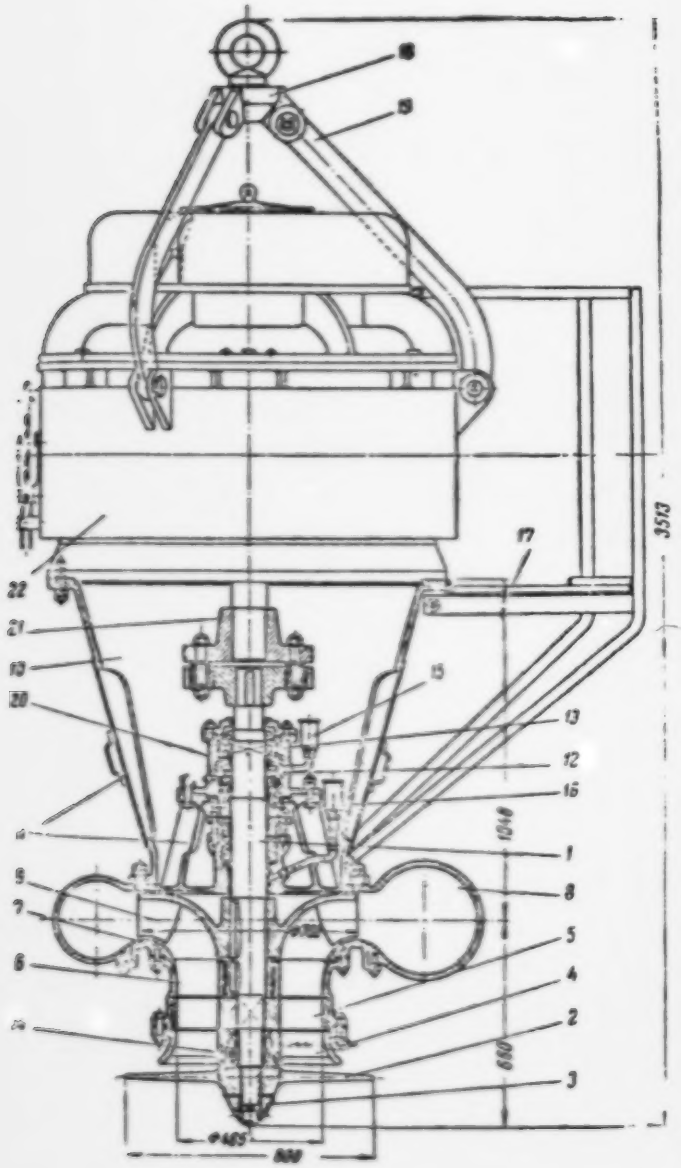


Curves shown as follows:

a) The $Q\text{-}H_1$; $Q\text{-}N_1$; $Q\text{-}\eta_1$ curves represent industrial tests on peat slurry;
b) The $Q\text{-}H_2$; $Q\text{-}N_2$; $Q\text{-}\eta_2$ and the $Q\text{-}H_3$; $Q\text{-}N_3$; $Q\text{-}\eta_3$ curves represent design calculations.

FIGURE A-22. COMPARISON OF PUMP CHARACTERISTICS OF THE TPD MODEL (1940) PEAT SLURRY PUMP (NEW STANDARD SYSTEM).

SOURCE: (4)



1- Drive Shaft; 2- Stump Deflector; 3- Nut; 4- Static Knife; 5- Axial Wheel; 6- Forwarding Guide; 7- Casing; 8- Casing with Voluted Chamber; 9- Impeller; 10- Transition Chamber; 12- Thrust Ball Bearing; 13- Radial Roller Bearing; 21- Flexible Coupling; 22- Electric Motor-160 kW, 580 RPM.

Note: The Peat Slurry Pump Model TPD (1938) for the Super Standard System pumps the peat slurry directly to the reservior with no further macerator.

FIGURE A-23. MODEL TPD (1938) PEAT SLURRY PUMP (SUPER STANDARD SYSTEM).

SOURCE: (4)

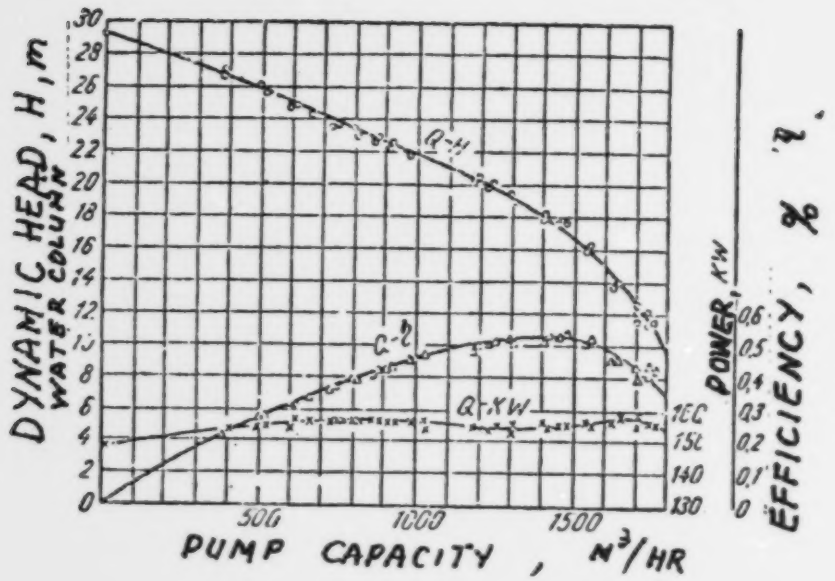
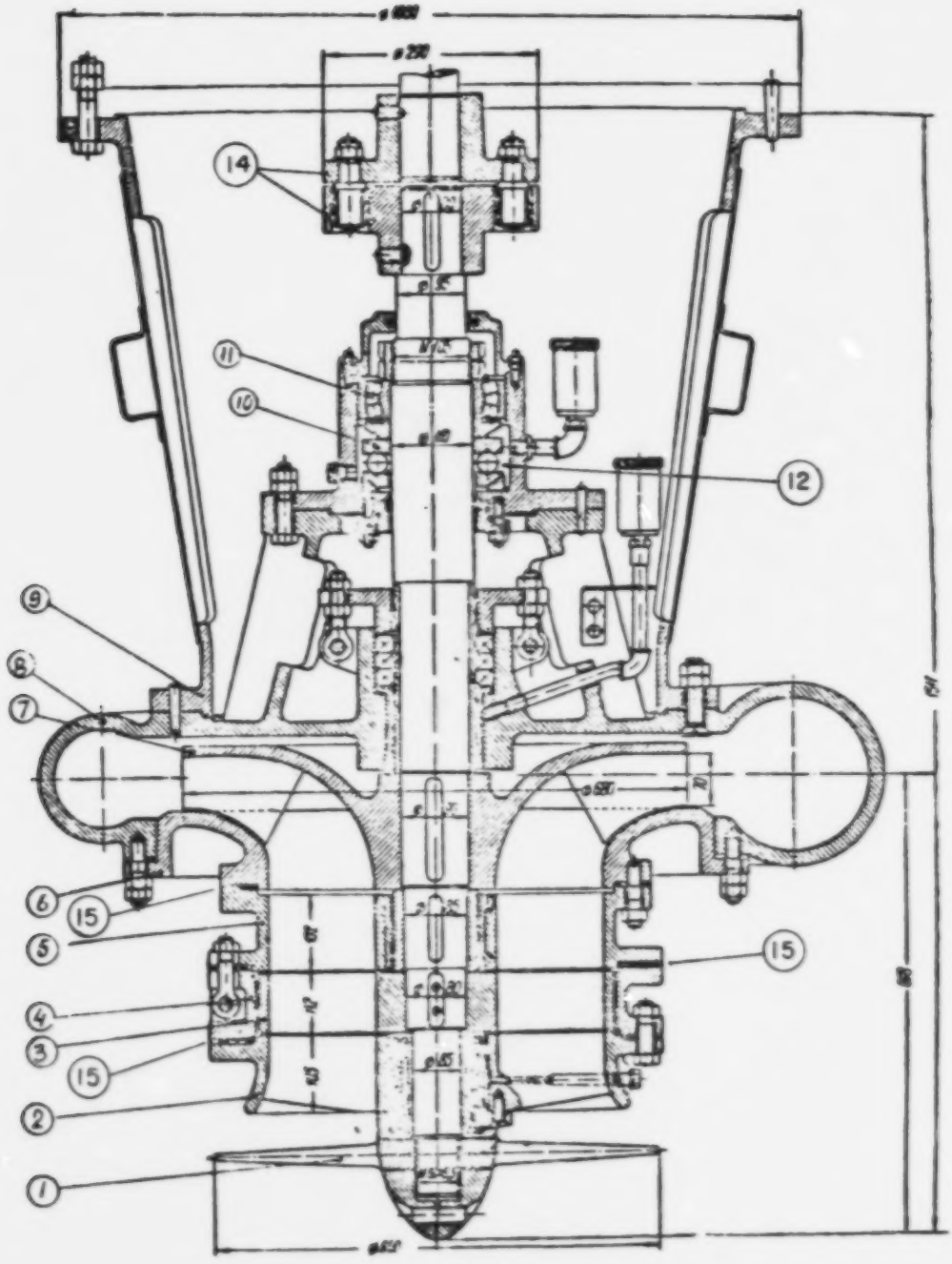


FIGURE A-24. PERFORMANCE CHARACTERISTIC OF THE MODEL TPD (1938) PEAT SLURRY PUMP (SUPER STANDARD SYSTEM) AT A PEAT SLURRY SOLIDS CONCENTRATION OF 2.6% (INDUSTRIAL TEST CARRIED OUT IN 1939 ON HIGHMOOR PEAT WITH A 20% DEGREE OF DECOMPOSITION).

SOURCE: (4)

APPENDIX B

Previous Design Information on the Main Components of the USSR Model TPD-4A Peat Slurry Pump/Macerator



1- Stump Deflector; 2- Static Knife; 3- Axial Wheel; 4- Shell; 5- Forwarding Guide; 6- Shaped Ring; 7- Impeller (Centrifugal Wheel); 8- Spiral Chamber; 9- Transition chamber; 10- Shaft; 11- Radial Roller Bearing; 12- Thrust Ball Bearing; 13- Tapered Roller Bearing; 14- Flexible Coupling; 15- Shims

Note: The peat slurry pump/macerator Model TPD 4A pumps the peat slurry directly to the reservoir.

FIGURE B-1. GENERAL VIEW OF THE PEAT SLURRY PUMP/MACERATOR, MODEL TPD-4A.
SOURCE: (8)

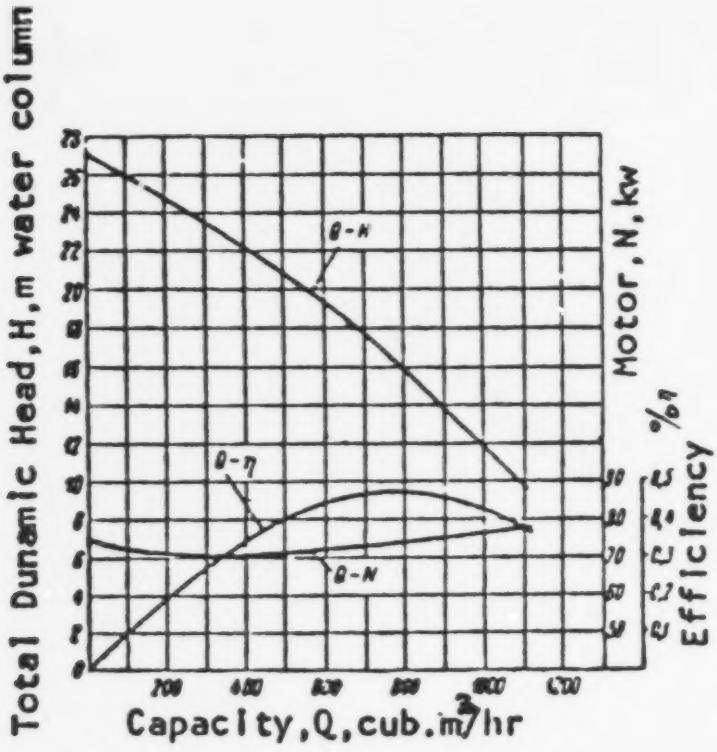


FIGURE B-2. MODEL TPD-4A PEAT SLURRY PUMP/MACERATOR PERFORMANCE CHARACTERISTICS.

SOURCE: (8)

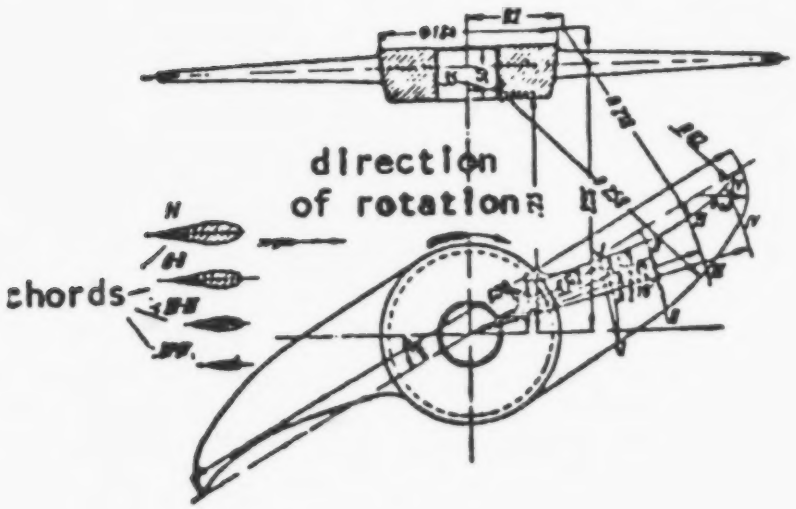


FIGURE B-3. MODEL TPD-4A STUMP DEFLECTOR

SOURCE: (8)

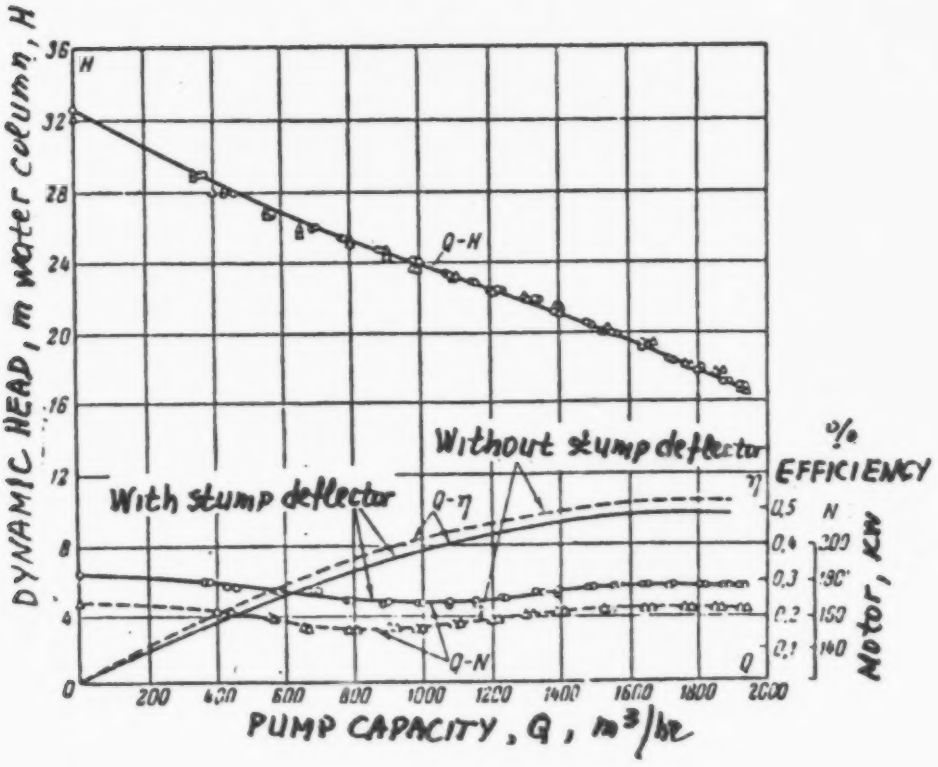


FIGURE B-4. MODEL TPD-5 PEAT SLURRY PUMP/MACERATOR PERFORMANCE CHARACTERISTICS WITH/WITHOUT STUMP DEFLECTOR.

SOURCE: (8)

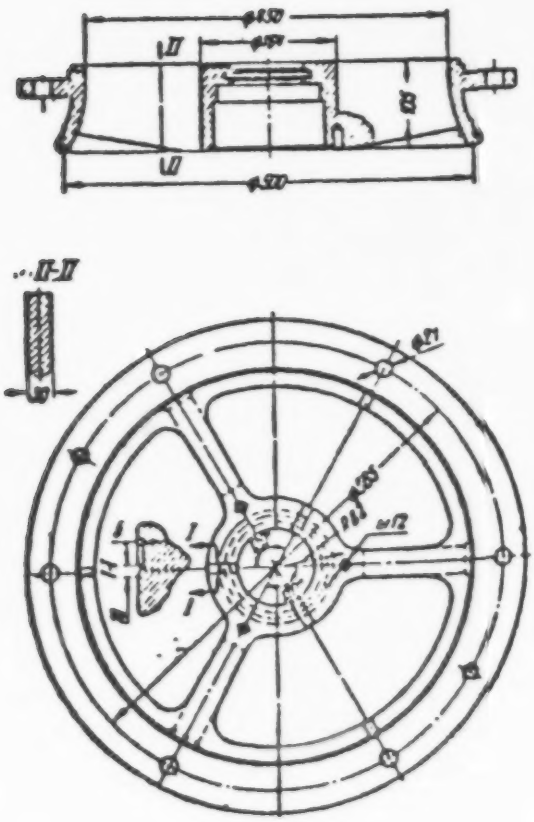
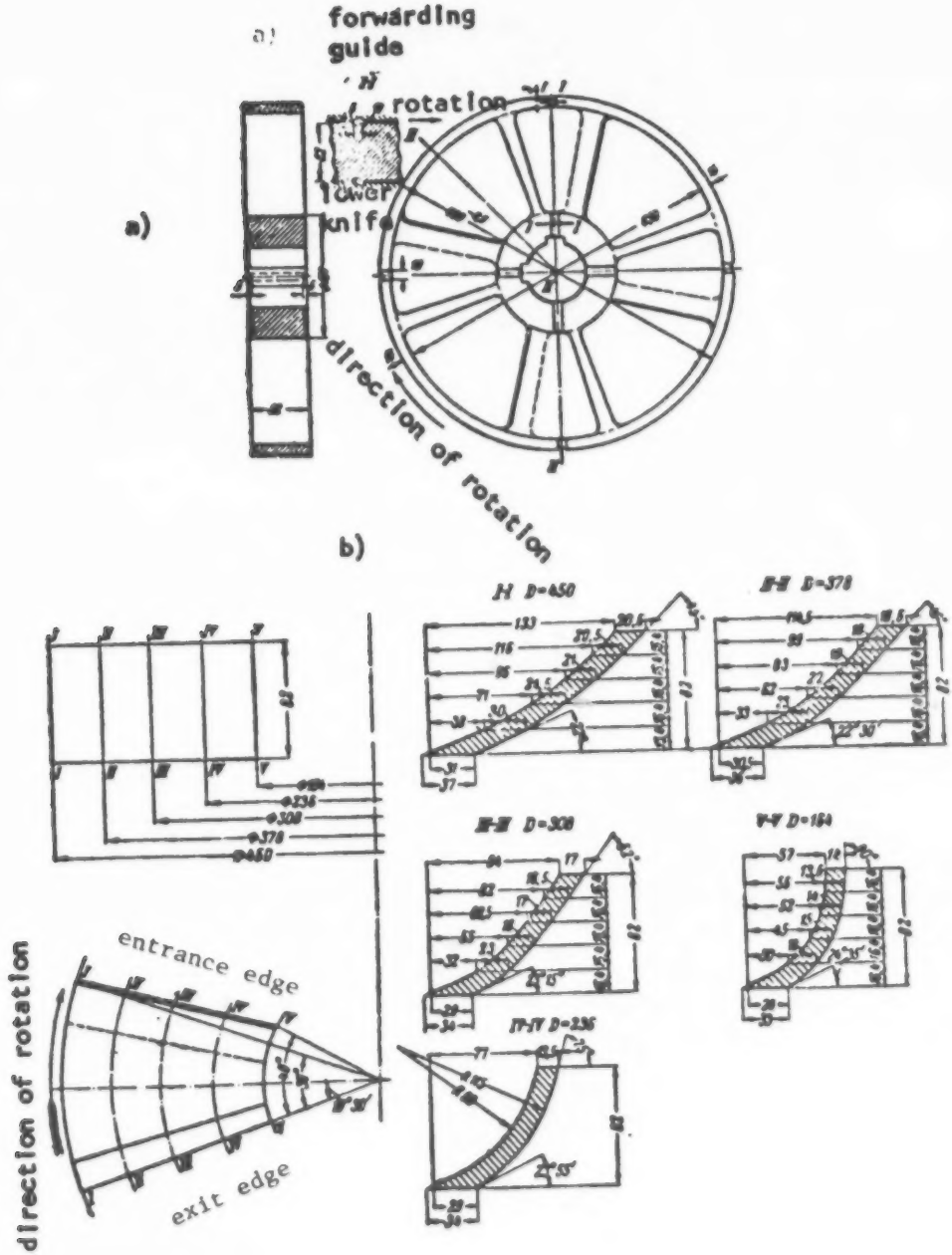


FIGURE B-5. MODEL TPD-4A STATIC KNIFE

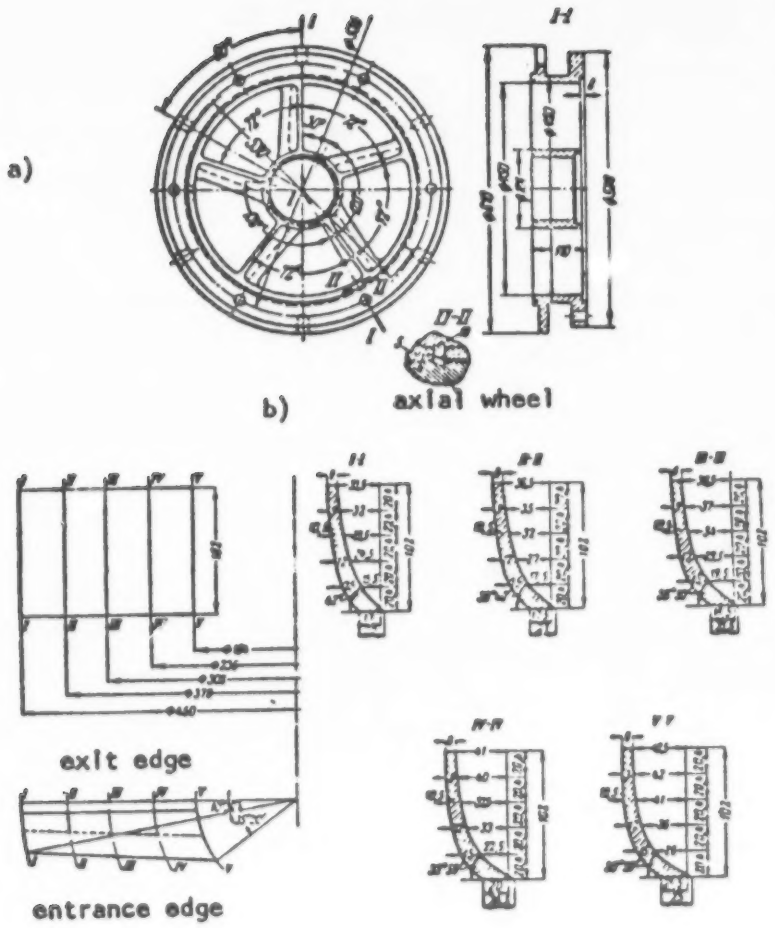
SOURCE: (8)



a) Section and top view;
b) Cross-sections of blades.

FIGURE B-6. MODEL TPD-4A AXIAL WHEEL

SOURCE: (8)



a) Plan view and cross-sections I-I;
b) Cross-section of blades.

FIGURE B-7. MODEL TPD-4A FORWARDING GUIDE

SOURCE: (8)

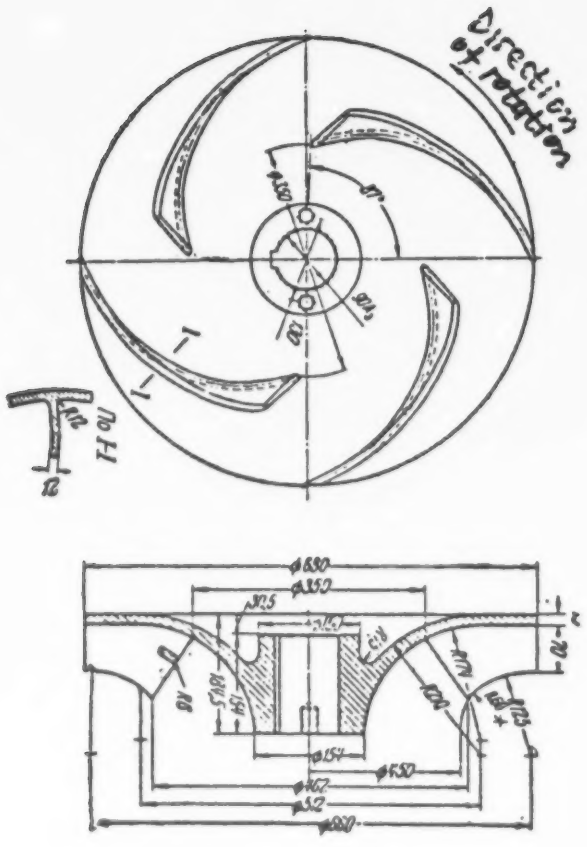
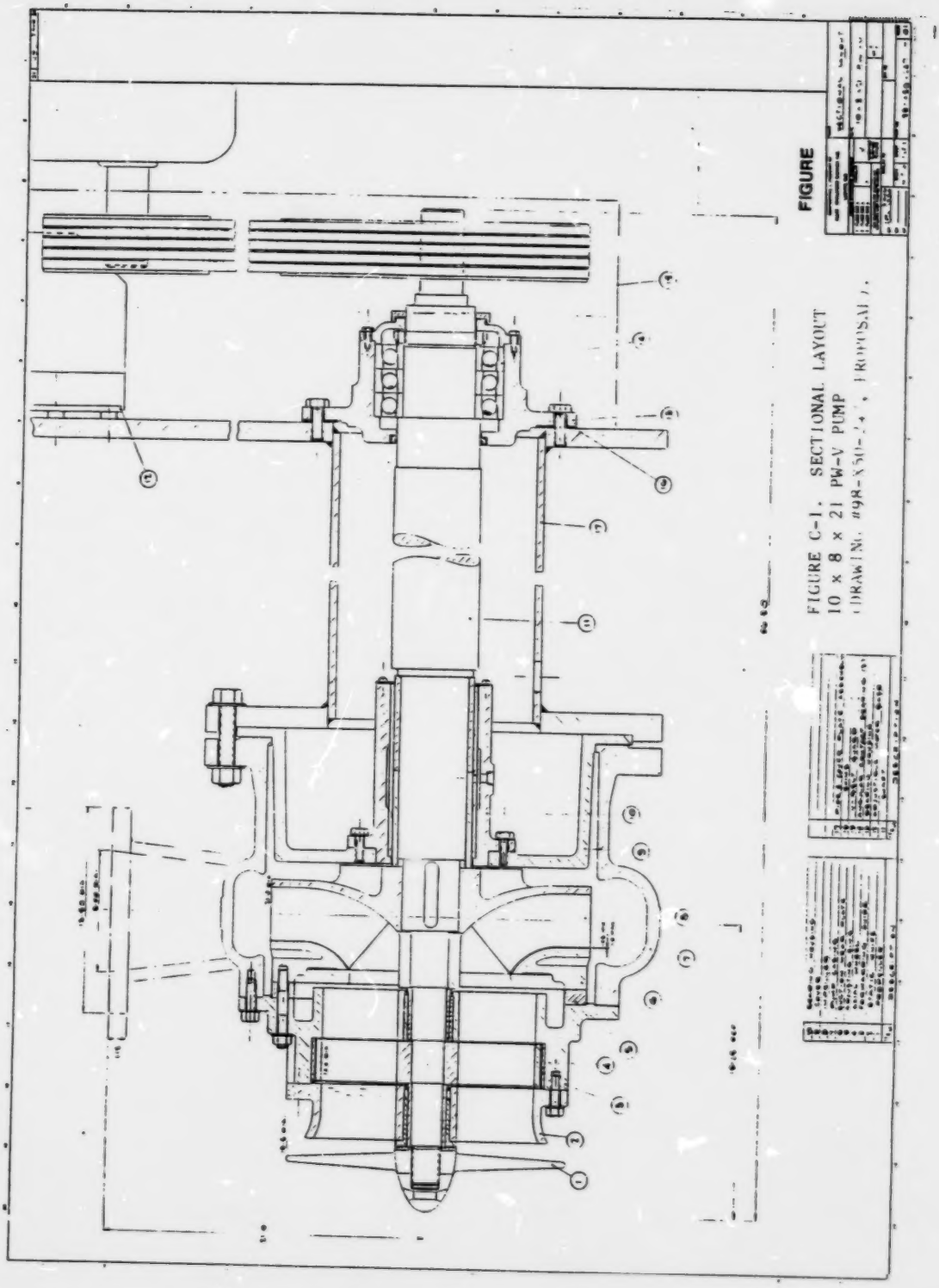


FIGURE B-8. MODEL TPD-4A IMPELLER (CENTRIFUGAL WHEEL).

SOURCE: (8)

APPENDIX C

Allis-Chalmers
Pump/Macerator Proposal



FIGURE

FIGURE C-1. SECTIONAL LAYOUT
10 x 8 x 21 PW-V PUMP
(DRAWING NO. #98-X50-24, 1 THOUSAND)

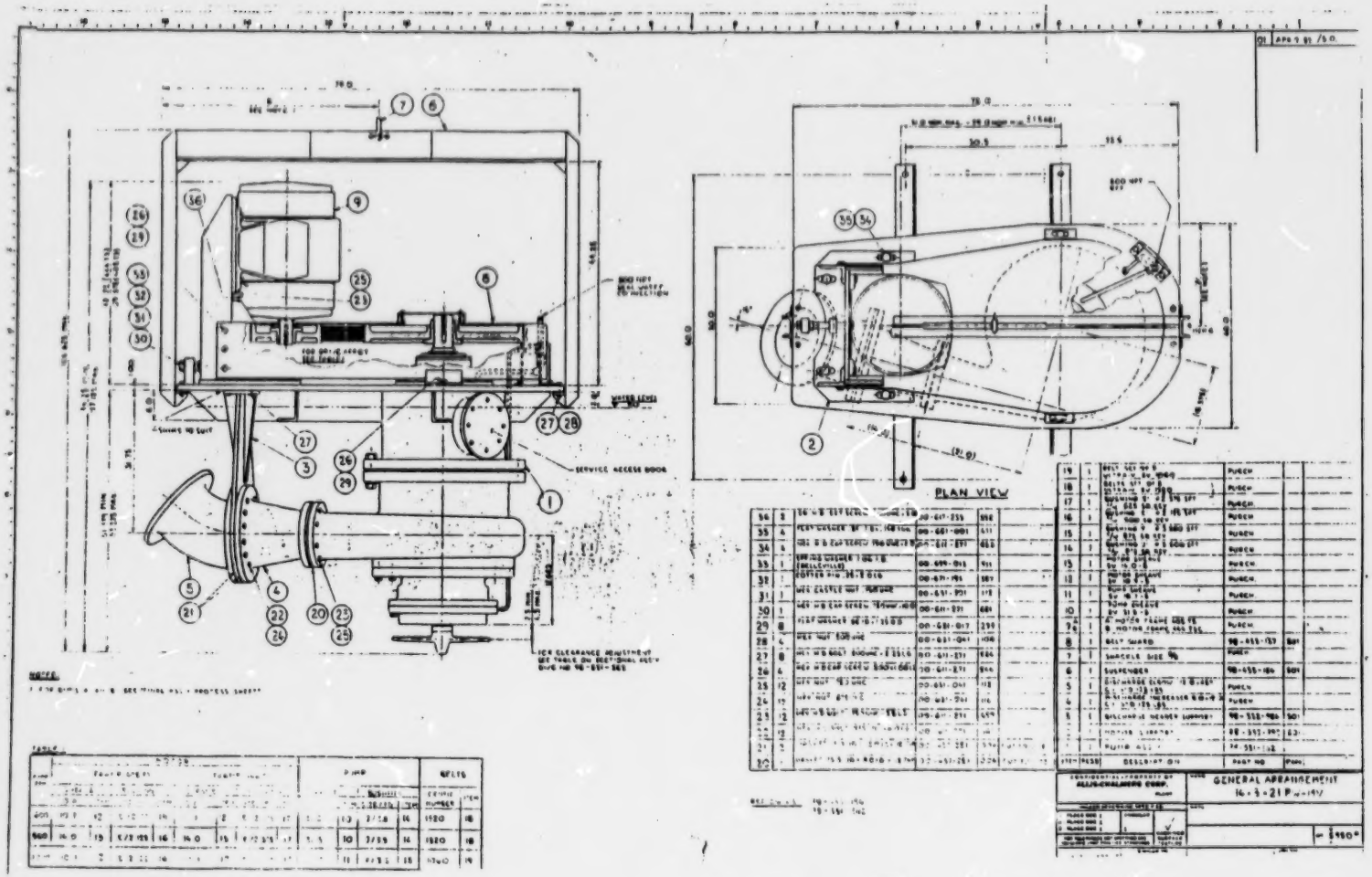


FIGURE C-2. GENERAL ARRANGEMENT 14 x 8 x 21 PA-M PUMP (DRAWING #98-433-151).

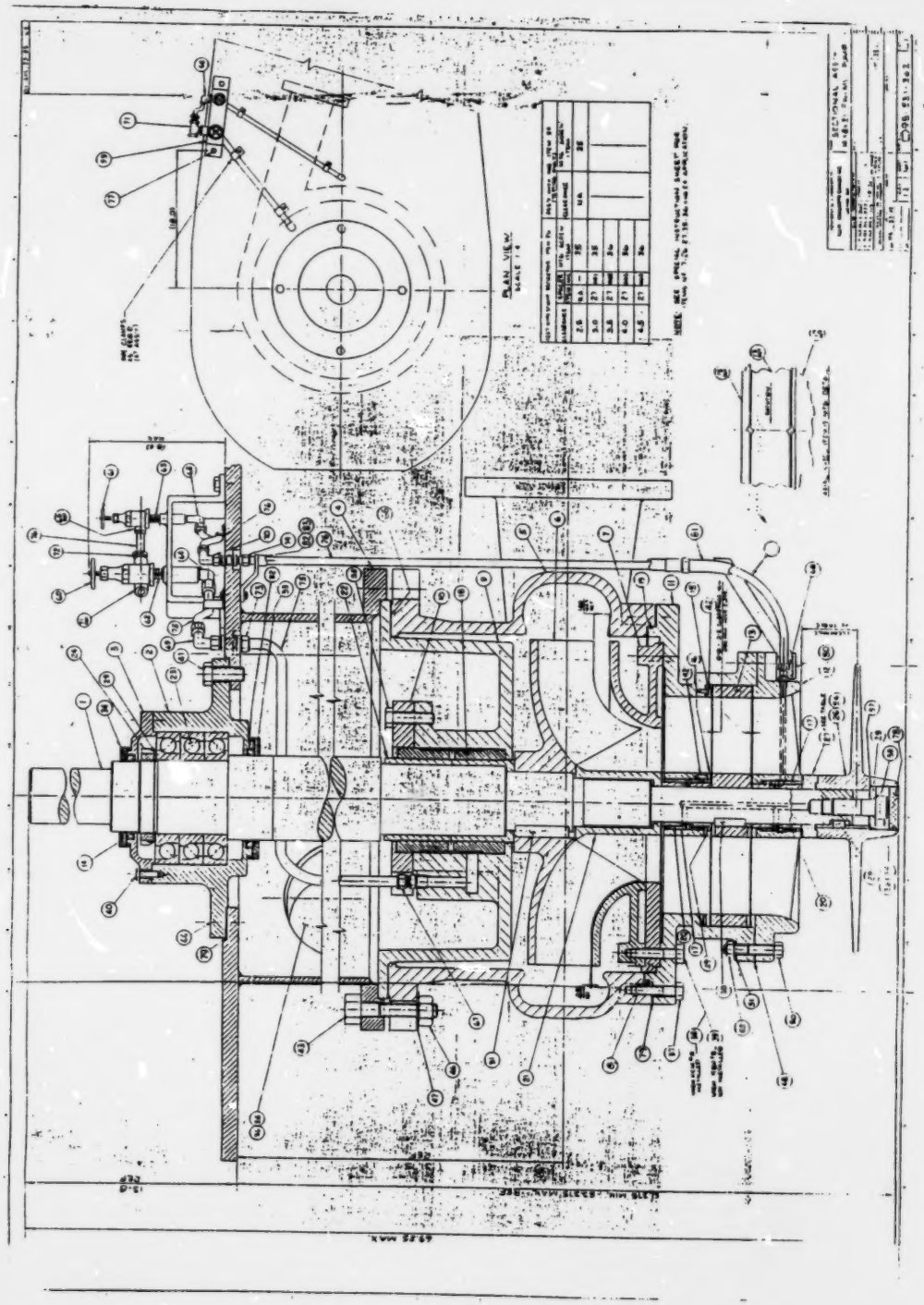


FIGURE C-3. SECTIONAL ASSEMBLY 14 x 8 x 21 PW-MV PUMP (DRAWING #98-531-362).

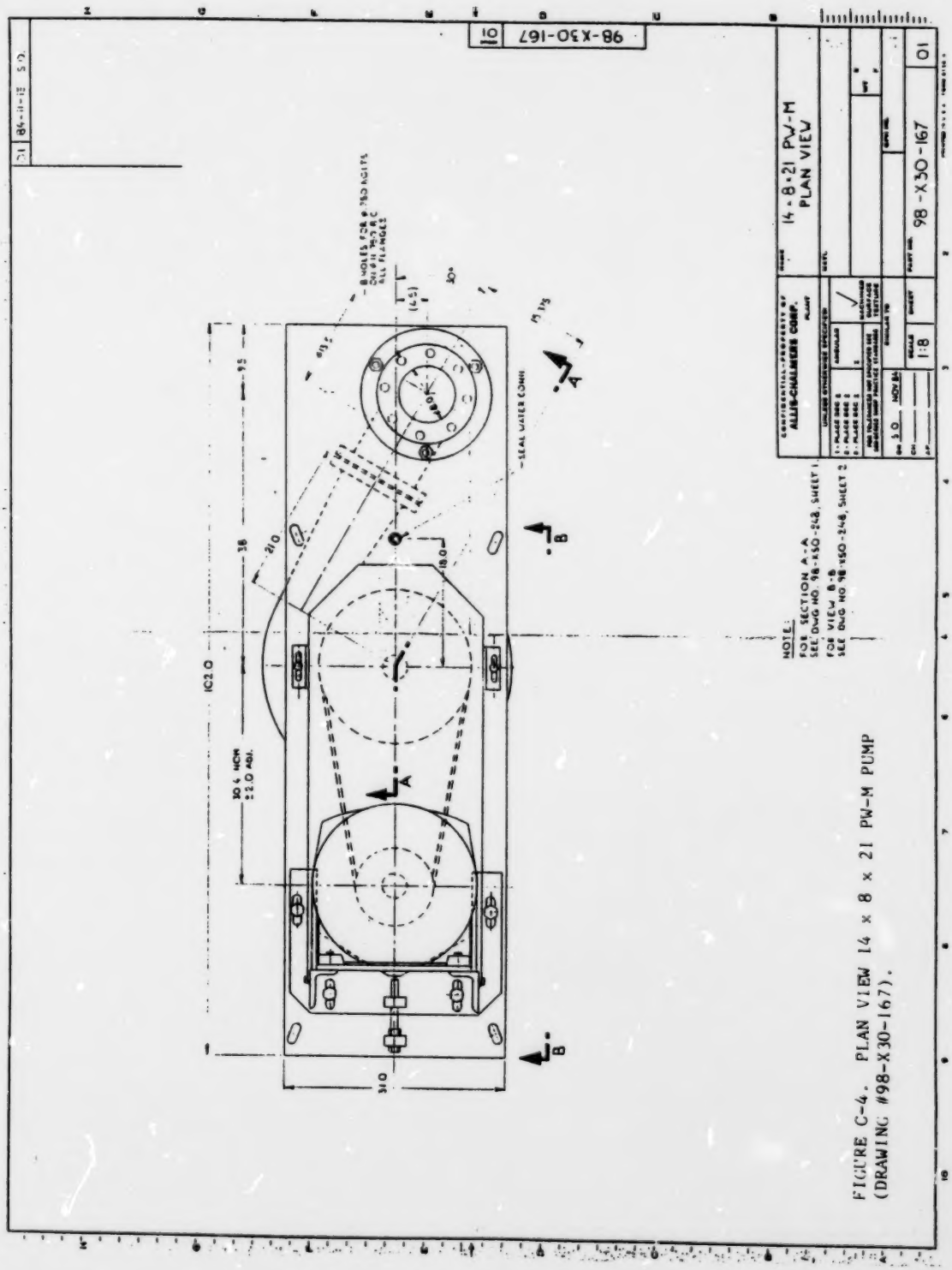


FIGURE C-4. PLAN VIEW 14 x 8 x 21 PW-M PUMP (DRAWING #98-X30-167).

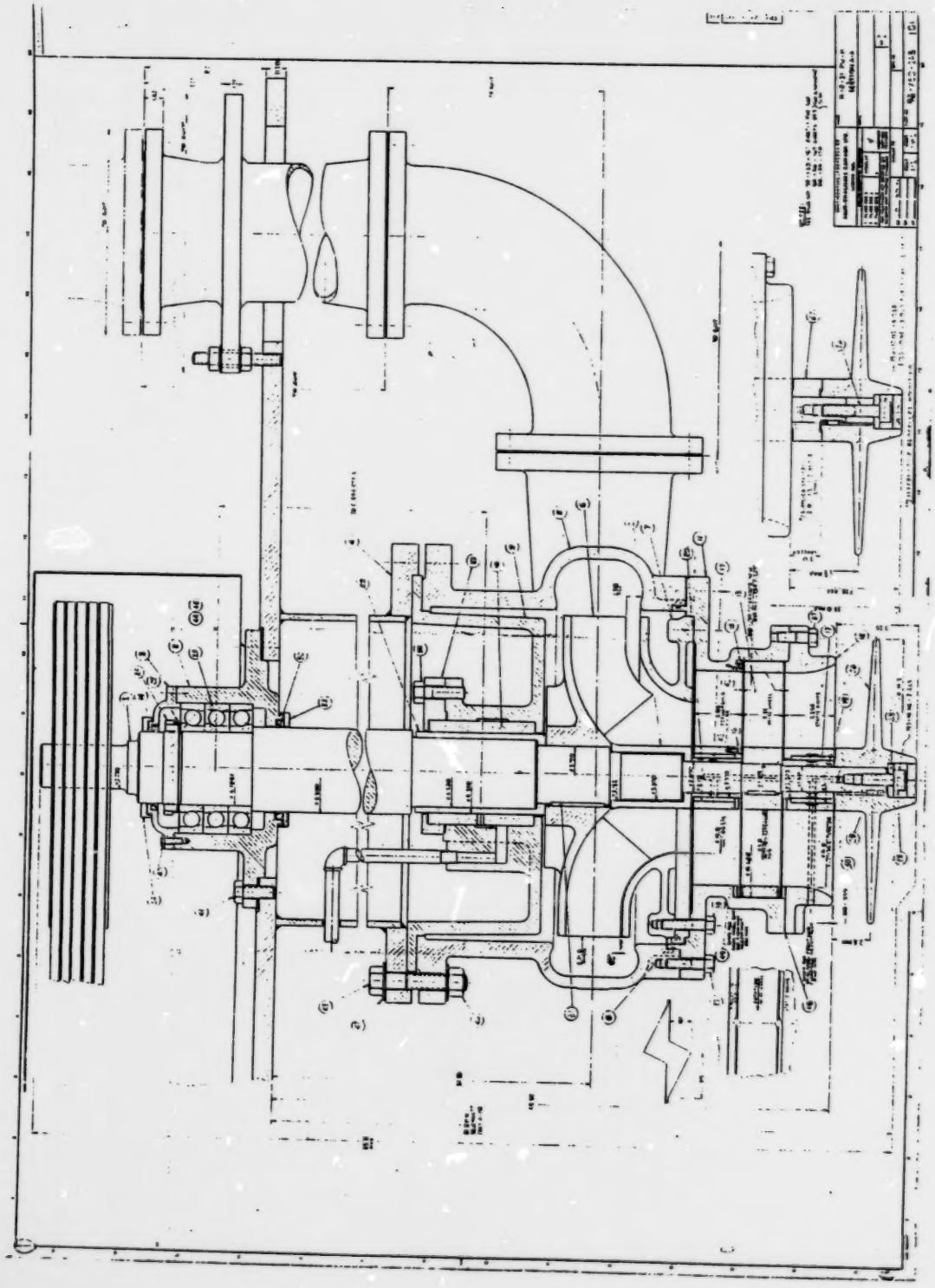


FIGURE C-5. SECTION A-A 14 x 8 x 21 PW-M PUMP
(DRAWING #98-X50-248, SHEET 1 OF 2).

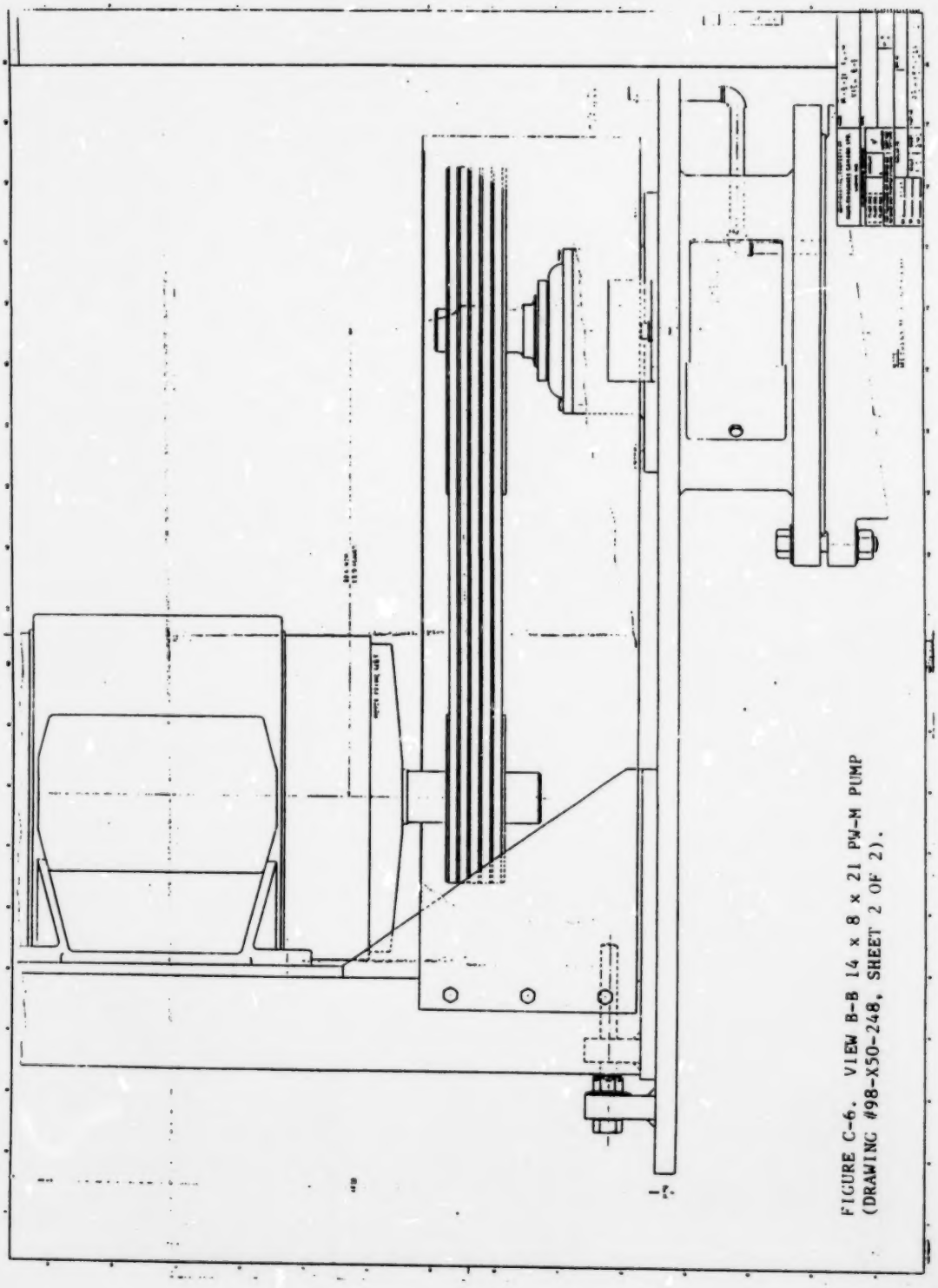


FIGURE C-6. VIEW B-B 14 x 8 x 21 PW-M PUMP
(DRAWING #98-X50-248, SHEET 2 OF 2).

No. Req'd Per Unit	Item	Description	Material	Drawing or CP *	Mark Number				
					501	502	503	504	505
1	1	SHAFT	1045 STL	98-433-142					
1	2	BRG HOUSING	C.I.	98-236-191					
1	3	BRG-HSG END PLATE	C.I.	98-350-263					
1	4	COVER PLATE	STL						
1	5	PUMP CASING	C.I.	98-332-971					
1	6	IMPELLER	316SS	98-530-741					
1	7	SIDEPLATE	C.I.	98-430-692					
1	8	SIDEPLATE SPACER	STL	98-332-979					
1	9	STUFFING BOX COVER	C.I.	98-330-425					
1	10	STUFFING BOX COVER END PLATE	C.I.						
1	11	FORWARDING GUIDE	CA-6NM	98-433-141					
1	12	STATIC KNIFE	CA-6NM	98-332-975					
1	13	AXIAL WHEEL	CA-6NM	98-433-140	001				
1	14	SHAFT SEAL							
1	15	OUTER CUTTING RING	CA-6NM	98-332-976					
1	16	INNER CUTTING RING	CA-6NM	98-236-194					
2	17	INNER BUSHING	DURIRON						
1	18	STUFFING BOX COVER BUSHING	DURIRON						
1	19	STATIC KNIFE SLEEVE	DURIRON	98-132-248					
1	20	FORWARDING GUIDE SLEEVE	316SS	98-132-247					
1	21	IMPELLER SPACER	316SS	98-236-195					
1	22	SHAFT SLEEVE	316SS	98-180-368					
2	23	ANGULAR CONTACT BRG-SKF 7224	STL						
1	24	BRG LOCK NUT SKF KM26 (H320X)	STL						
2	25	BRG LOCK WASHER SKF MB4	STL						
1	26	PROPELLER	CA-6NM						
1	27	PROPELLER SPACER	316SS	98-132-250					
1	28	PROPELLER GASKET	STL	98-132-249					
1	29	PROPELLER KEY	STL						
1	30	AXIAL WHEEL KEY	STL						

FIGURE C-7. ASSEMBLY LIST 14 x 8 x 21 PW-MV PUMP (SHEET 1 OF 3).

CONFIDENTIAL PROPERTY OF CANADIAN ALLIS-CHALMERS LTD.

ASSY LIST 14 x 8 x 21 PW-MV SIMILAR TO

1 OF 3 RE 98-X50-248

NO REQ'D PER UNIT	ITEM	DESCRIPTION	MATERIAL	DRAWING OR CP	MARK NUMBER				
					501	502	503	504	505
1	31	IMPELLER KEY	STL						
1	32	SHAFT SEAL							
1	33	SHAFT DEFLECTOR LOWER	RUBBER						
1	34	SHAFT DEFLECTOR UPPER	RUBBER						
5	35	HEX. SOCK'D MACH. SCREW .750UNC-2.0LG (WITHOUT OR WITH PROPELLER SPACER UP TO 5)	STL						
4	36	ALTERNATIVE WITH PROPELLER SPACER LG-2.0	STL						
8	37	HEX. H'D CAP SCREW .625UNC-2.5LG	STL						
8	38	.625 UNC-1.75LG	STL						
8	39	.625UNC-2.75LG (ALTERNATIVE WITH SHOE PLATE SPACER)	STL						
1	40	.500UNC-1.50LG	STL	00-611-271	548				
4	41	.875UNC-2.0 LG	STL						
12	42	HEX SOCK'D MACH. SCREW .250UNC-.50 LG	STL						
6	43	HEX NUT .375UNC-.516	STL						
2	44	SCREW .500UNC-3.0LG	STL	00-617-247	560				
2	45	COTTER PIN NO. 8-2.0LG	STL						
6	46	HEX. NUT .500UNC	STL						
10	47	FLAT WASHER F.F. ID-.2.0 OD-.125THK	STL						
10	48	SHIM 1.550 ID-2.0 OD-.005THK	STL						
10	49	SHIM 1.880 ID-2.500 OD-.005THK	STL						
21	50	HEX. H'D CAP SCREW .500UNC-8.0LG	STL						
1	51	HEX. CASTLE NUT .500UNC-.516	STL						
1	52	COTTER PIN NO. 12-2.0LG	STL						
12	53	SPRING WASHER .500	STL						
12	54	HEX H'D CAP SCREW .500UNC-1.5LG	STL						
12	55	HEX. H'D CAP SCREW .500UNC-2.0	STL						
12	56	FLAT WASHER .812ID-1.250OD-.109	STL						
4	57	MOTOR BELT	STL						
1	58	[illegible]	STL						
1	59	BELT GUARD	STL						
1	61	MOTOR SUPPORT	STL						

FIGURE C-7. ASSEMBLY LIST 14 x 8 x 21 PW-MV PUMP (SHEET 2 OF 3).

CONFIDENTIAL PROPERTY OF ALLIS-CHALMERS LTD

REQ'D PER UNIT	ITEM	DESCRIPTION	MATERIAL	DRAWING OR CP	MARK NUMBER				
					501	502	503	504	505
4	66	HEX HD CAP SCR .750 UNC x 2.5 LG	STL						

FIGURE C-7. ASSEMBLY LIST 14 x 8 x 21 PW-MV PUMP (SHEET 2 OF 3).

CONFIDENTIAL PROPERTY OF CANADIAN ATLAS CRANE LTD.

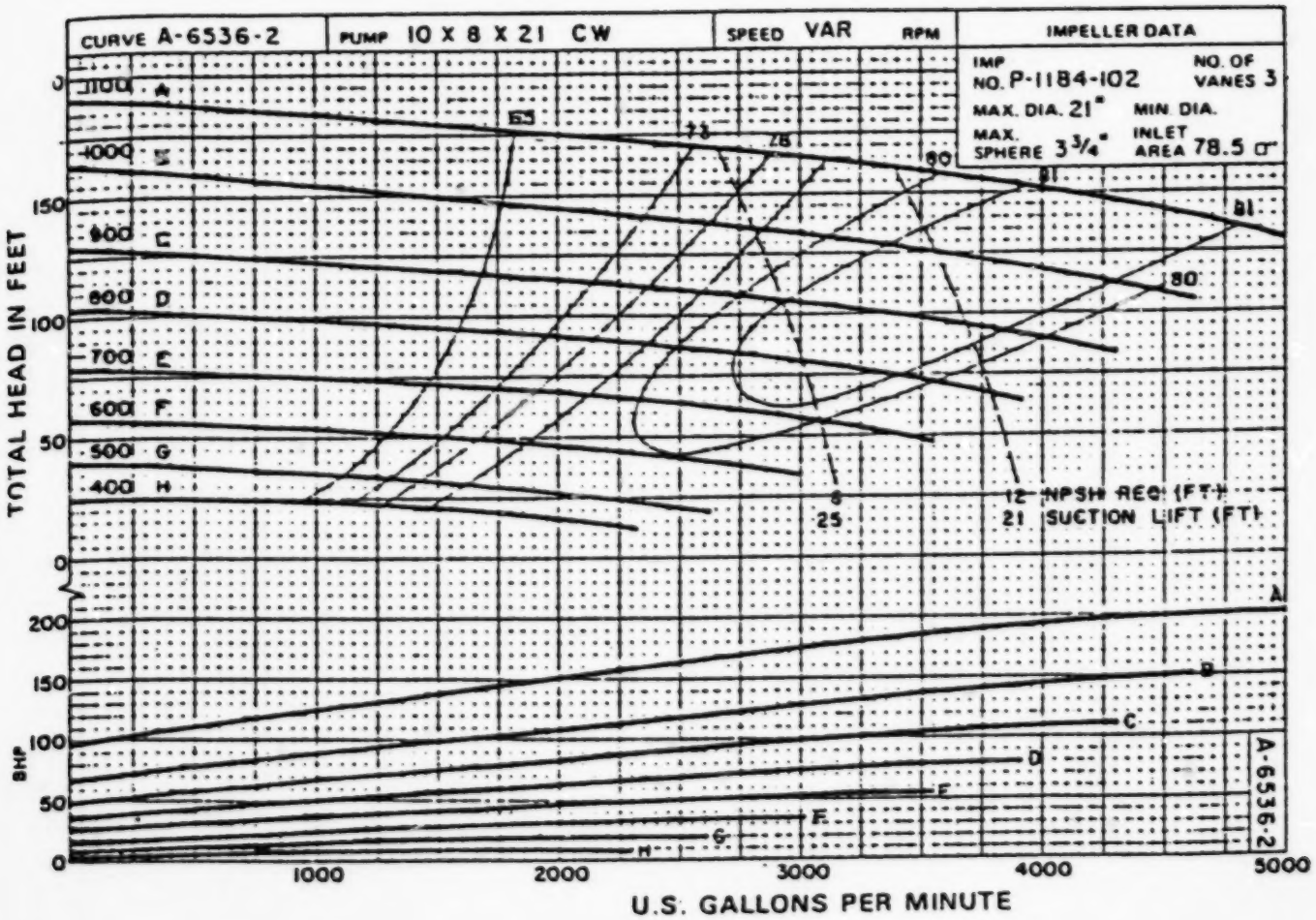


FIGURE C-8. VARIABLE SPEED CURVES FOR THE PUMP 10 x 8 x 21 CW SUPPLIED WITH STANDARD CLEARANCE (CURVE NO. A-6536-2, PROPOSAL).

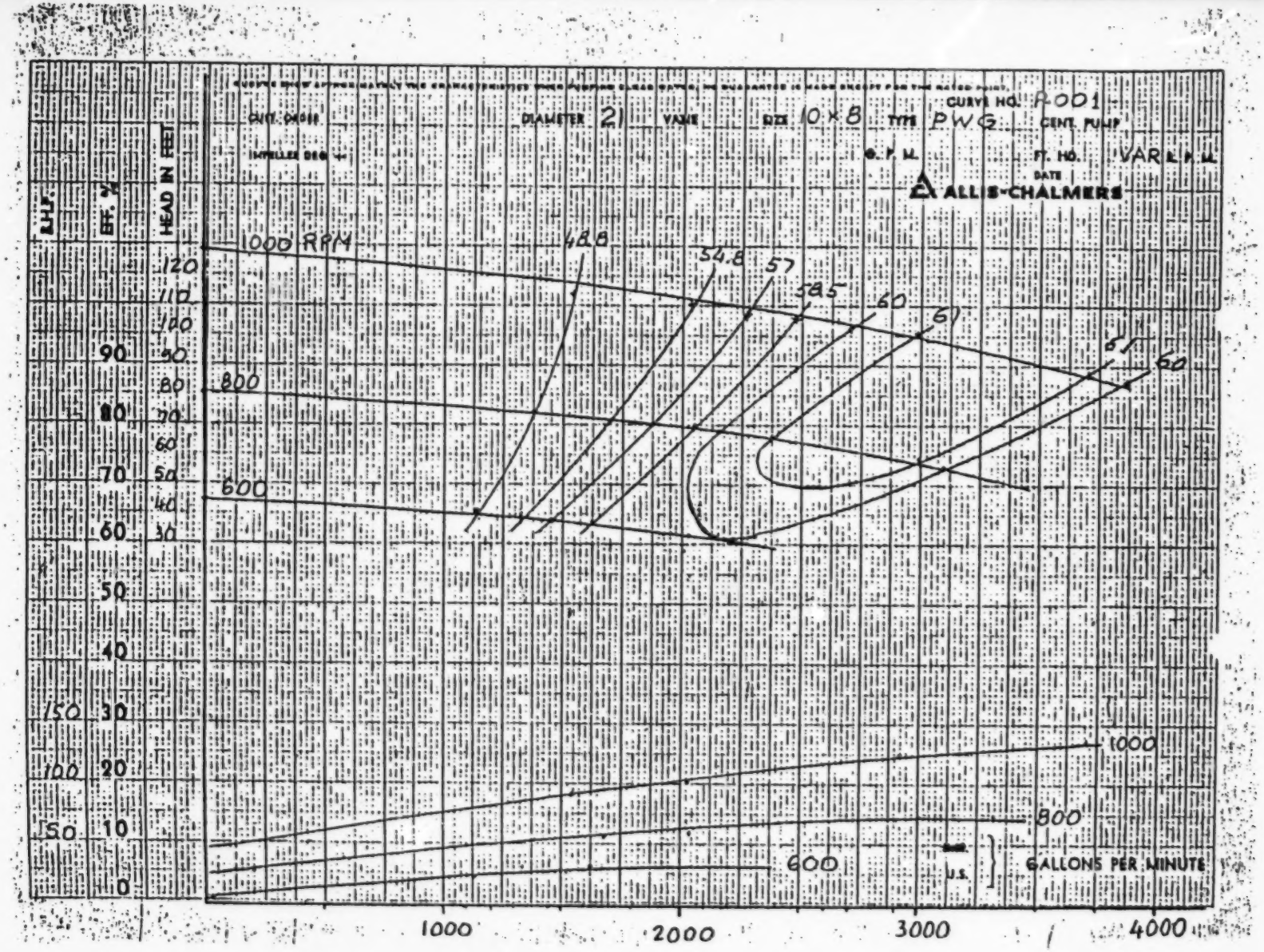


FIGURE C-9. VARIABLE SPEED CURVES FOR THE PUMP 10 × 8 PWG SUPPLIED WITH A 1 INCH CLEARANCE BETWEEN THE IMPELLER AND THE SUCTION WEAR PLATE (CURVE NO. P-001, PROPOSAL).

*
MONENCONT TOR

CANAC LACHINE
JULY 13/84

ATTN G W MANKINEN

RE PEAT SLURRY PUMP/MACERATOR

CONF DISCUSSIONS HELD IN YOUR OFCES ON JULY 9/84 TAKING INTO CONSIDERATION THE MOISTURE/AIR ENTRAINMENT/VISCOSITY/THIXOTROPIC PROPERTIES PEAT WE PROPOSE TO MODIFY THE ORIGINALLY OFFERED UNIT TO INCORPORATE THE FOLLOWING:

1. V-BELT DRIVE USING A STD ODP 125 HP MOTOR 550/3/60 RUNNING AT1770 RPM APPROX PLACED VERTICALLY WITH THE SHAFT DOWNWARDS AND A PUMP SPEED UNDER 1000 RPM
2. INLET/MACERATOR WITH A 14 INCH DIAM OTHERWISE DESIGN UNCHANGED
3. MODIFIED 14MS PWG OR PUMP WITH 1 INCH CLEARANCE BETWEEN IMPELLER AND SUCTION SIDE PLATE TO HELP OVERCOME AIR ENTRAINMENT THE MECHANICAL END WOULD CONSIST OF WATER LUBRICATED RADIAL BEARING ADJACENT TO IMPELLER-THRUST WOULD BE TAKEN BY THRUST BEARING IN FLOOR PLATE WHICH ALSO CARRIES THE MOTOR ESTIMATED WEIGHT OF UNIT INCLUDING MOTOR/5000 LBS MATLS WOULD BE AS FOLLOWS: CASING COVER AND SIDEPLATE CAST IRON IMPELLER STAINLESS COLUMN AND FLOOR PLATE MILD STEEL DEFLECTOR/MACERATOR ASSY CAGNM STAINLESS ENH 275 APPROX

PLS NOTE WE HAVE SELECTED A 125 HP MOTOR TO ALLOW FOR ALL UNKNOWNS THE COST OF THE UNIT INCLUDING THE DRIVE AND 125 HP MOTOR AND A PERFORMANCE TEST ON WATER WILL BE [redacted] THIS DOES NOT INCLUDE ANY FIELD SERVICE WORK START UP COST IN THE EVENT OF AN ORDER WE WOULD DISCUSS THE DESIGN AND THE UNIT TO MEET A CERTAIN RATING HOWEVER CAN ONLY GUARANTEE THE PERFORMANCE ON WATER

SHOULD MODIFICATIONS BE REQUIRED TO IMRPOVE THE PERFORMANCE OF THE UNIT WE ARE PREPARED TO WORK WITH YOU HOWEVER WE MUST COME TO AN AGREEMENT FOR RECOVERING ANY ADDITIONAL COSTS - E AIR EVACUATION WE HAVE CONSIDERABLE EXPERIENCE IN THE PAPER INDUSTRY TO CONFIRM THAT RUNNING WITH LARGE CLEARANCES IS EFFECTIVE IN EVACUATING AIR DUE TO SUMMER SHUT DOWN WE REGRET WE CANT SUBMIT FORMAL PROPOSAL OR DWGS BEFORE MID AUGUEST 1984 MEANWHILE PLS ADVISE IF YOU NEED FURTHER CLARIFICATION OR MODIFICATION

A AHAD
ALLIS CHALMERS CDA INC
TLX 05321825

*
MONENCONT TOR

CANAC LACHINE

FIG. C-10

ALLIS-CHALMERS
CANADA INC.

125 ST. JOSEPH,
LACHINE, QUEBEC, H8S 2L2
TELEPHONE 514 - 634-3451

August 17, 1984

Montreal Engineering Company Ltd.,
Colonia Place,
Two St. Clair Avenue East,
Toronto, Ontario.
M4T 2T5

RECEIVED
AUG 23 1984

Attention: Mr. G.W. Mankinen

Re: Peat Slurry Pump/Macerator
W.O. MEB 7951-2
Our Ref: G-1708

Gentlemen:

This is in confirmation of our telex dated July 13, 1984, Based on the discussions held in your office on July 9, 1984, we have modified our original proposal to incorporate the following features as seen in dwg. 98-X50-247 -

- Enlarged inlet/macerator to reduce tendency to plug.

- Modification of the 10x8 casing to have a 14" connection matching the 14" macerator. The clearance between the impeller and sideplate will be set originally at 1" to allow enough recirculation to dislodge any air entrainment bubble forming at the impeller eye. Provision will be made to alter the clearance without major modification.

- V-belt drive arrangement to allow vertical mounting of a standard O.D.P. 1800 RPM motor and a pump speed of 1000 RPM approx. This arrangement would allow a low cost modification of the speed which, together with pump clearance adjustment, would permit an infinite number of speed/clearance variations to experiment with increased solids concentrations.

- The mechanical end now consists of a lower water lubricated bearing and an upper thrust bearing mounted on the floor plate.

The materials would be as follows:

Pump casing, cover & sideplate	-	Cast Iron
Impeller	-	Stainless
Column & floor plate	-	Mild Steel
Deflector/Macerator Assy	-	Stainless CA6NM (275 BNH)

Because of the uncertainties, due to the viscous/ thixotropic/air entrainment properties of peat, we have selected an oversized motor of 125 HP. Based on water performance with a 1" clearance at 1000 RPM, we estimate the pump will deliver 3000 USGPM at 85 ft. and absorb 107 HP. At 100 ft. head, we estimated a flow of 2100 USGPM and a BHP of 96 HP.

The cost for supplying the unit with motor and drive, including a water test as described above, will be [redacted]. This price does not include any start-up cost. Our liability is limited to supplying a pump as described above, to meet a specified rating confirmed by a performance test on water. Any field visitations and modifications required after the original testing are not included in the price and would be done on a cost plus basis.

Based on our experience in the paper industry, we feel confident that an air-evacuation system will not be necessary. Should the original field tests prove not entirely satisfactory, we feel that with the flexibility of our design, field modifications can be made quickly and at minimum cost.

We trust the above is satisfactory and hope you will be successful in your project.

Yours very truly,

AA/rz

A. Ahad,
Manager, Pump Operations

ALLIS-CHALMERS
CANADA INC.

185 DAWSON ROAD
GUELPH, ONTARIO, N1H 1A4
TELEPHONE: 519 - 824 - 7750
TELEX: 069 - 56524

October 4, 1984

Montreal Engineering Company Ltd.,
155 Rexdale Blvd.,
Rexdale, Ontario.
M9W 5Z8

RECEIVED
OCT 10 1984

Attention: Mr. E.W. Mankinen

Re: Peat Slurry Pump/Macerator
W.O. MEB 7951-2
Our Ref: E-1708

Gentlemen,

This in reference to the discussions held in your office in Montreal on October 1,1984.

As requested we are attaching herewith 2 variable speed curves for the proposed unit. Curve No. A-6536-2 if for the pump supplied with standard clearance and Curve No. P-0001 is for the pump supplied with a 1" clearance between the impeller and the suction wear plate. These curves are based on the performance of the standard production unit without the macerator/deflector assembly.

We have no available information to allow us to accurately predict the effect of the macerator/deflector assembly. On water, we estimate a loss of 3 to 5% in efficiency.

As regards to the effect of viscosity and entrainment on the performance of the pump, we have no data on peat to allow us to predict their effect. The Hydraulics Institute has data on the effect of viscosity on the performance of a centrifugal pump; however, this is based on clear liquids and not on a solids/liquid mixture. The Pulp & Paper Research Institute have data on the paper stock freeness/air entrainment however we would hesitate to use this data on peat.

Our proposal dated August 17, 1984, is based on a unit supplied fully assembled with 1" clearance and tested with the job motor and belt drive suitable for 1000 R.P.M.

We have reviewed your testing requirements with the Cincinnati plant where the performance test would take place. On the basis of our discussions, the situation is as follows:

1. To test a vertical pump, the factory cannot utilize any of its vertical test motors which are all of the hollow shaft type designed for vertical turbine pumps.

This type of motor cannot be readily used with the pump we are offering due to the bearing design of our unit. It would be extremely expensive and time consuming to modify the pump to accomodate the test motors. Accordingly we can only test using the V-Belt drive and the job motor.

2. To test at any speed above 1000 R.P.M. we would have to increase the size of the motor. Since the data of the Russian pump we are trying to emulate shows a head of only 20 meters, we suggest tesing at 600, 800 and 1000 R.P.M. utilizing the job motor.

3. In order to test the unit without the macerator and deflector it would be necessary to dismantle the unit and fit it with a special spacer sleeve and nut. Also, to test the unit with a standard 0.015" clearance and a 1" clearance it would be necessary to dismantle it and fit special spacers and repeat this operation for each test. This would add several thousand dollars for Engineering special parts repeated testing, etc.

Since the unit will never operate in the field without the macerator/deflector assembly and is likely to airbind with a small clearance between impeller and sideplate, we feel that there is no practical benefit in shop testing any configuration other than what will be actually tested in the field.

In summary, we propose to supply the unit as detailed in our letter dated August 17, 1984 with the following additions and provisions;

- Discharge piping up to 4" above the coverplate. This piping would be clamped to the floor plate to minimize thrust.
- Eye bolts mounted on the floor plates to allow lifting the unit including the motor as an assembly.
- Design the keys holding the deflector and macerator to shear under severe torque.
- Shop testing at 1000, 800, and 600 R.P.M. including the supply of the necessary sheaves.

The price breakdown will be as follows:

Basic unit consisting of deflector, macerator, pump, discharge piping, floor plate, V-Belt drive and motor support plate.	[redacted]
125 HP motor TEFC, 1800 R.P.M., 575V/3/60.	$ 5,000.
Additional sheave sets for 800 and 600 R.P.M. testing.	$ 1,500.
Shop testing for unit at 1000, 800, and 600 R.P.M.	$ 4,000.
Addition for witness testing (1 day).	$ 1,000.

After testing the unit will be shipped collect F.O.B. Guelph to the specified site.

Based on receipt of an order by October 19, 1984, we can effect delivery by May 31, 1985 provided drawing approval is received within 1 week from presentation and we are allowed to proceed with ordering material within 6 weeks from receipt of the order.

Payment Terms: 25% with the order
60% upon completion of manufacture
15% upon test completion and notification of readiness to ship

We trust the above is satisfactory and look forward to working with you on this project.

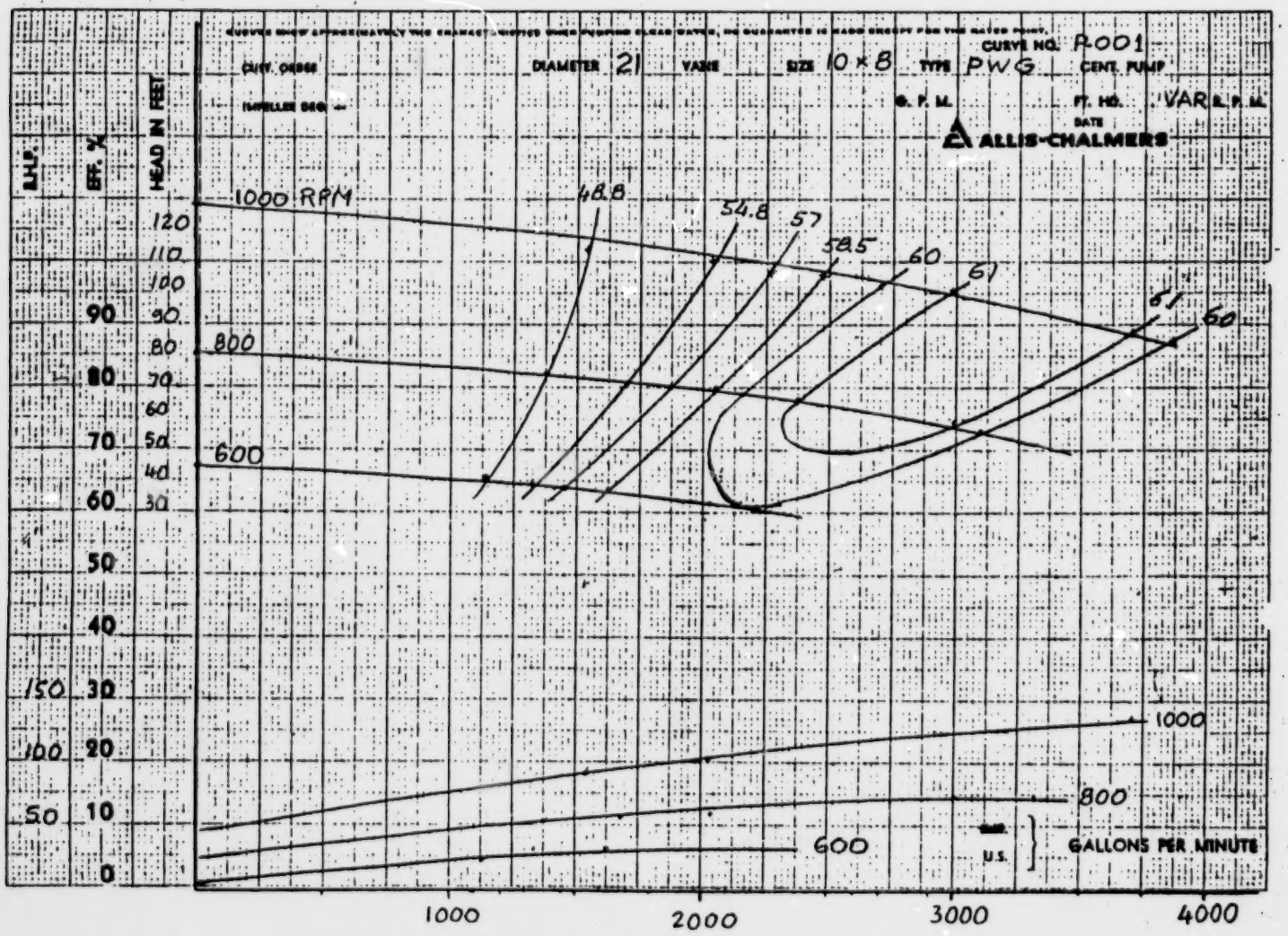
Sincerely,

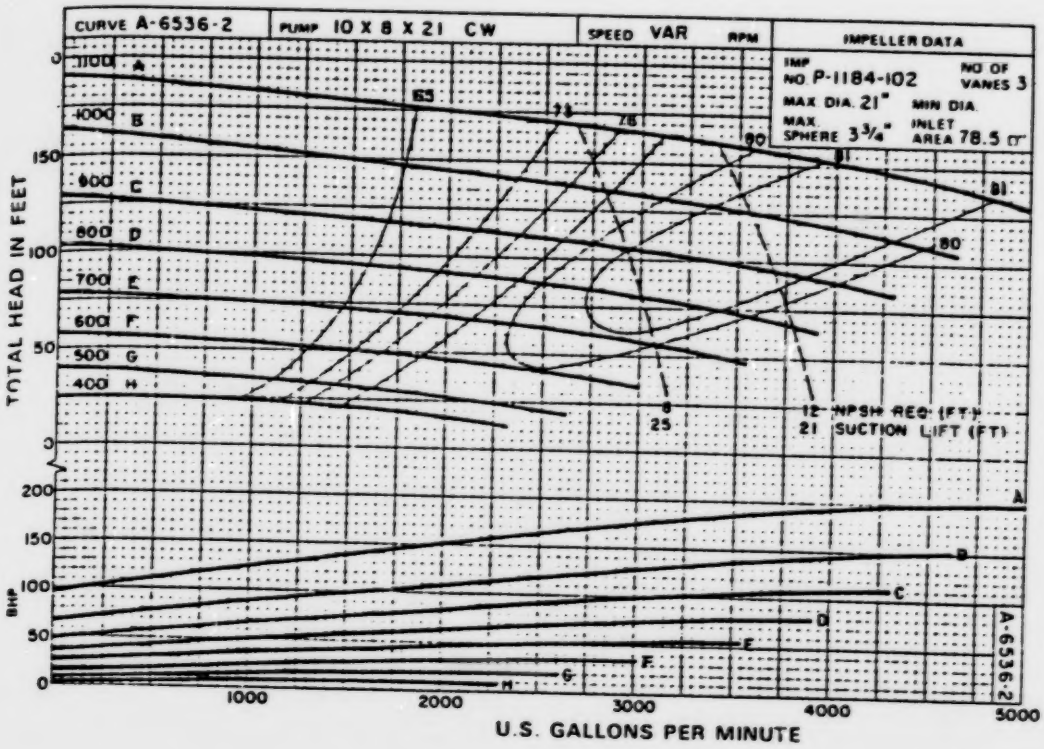
A. Ahad,
Manager, Pump Operations.

:jl

cc. Mr. Ted Tibbetts
Mr. Chris Snejdar

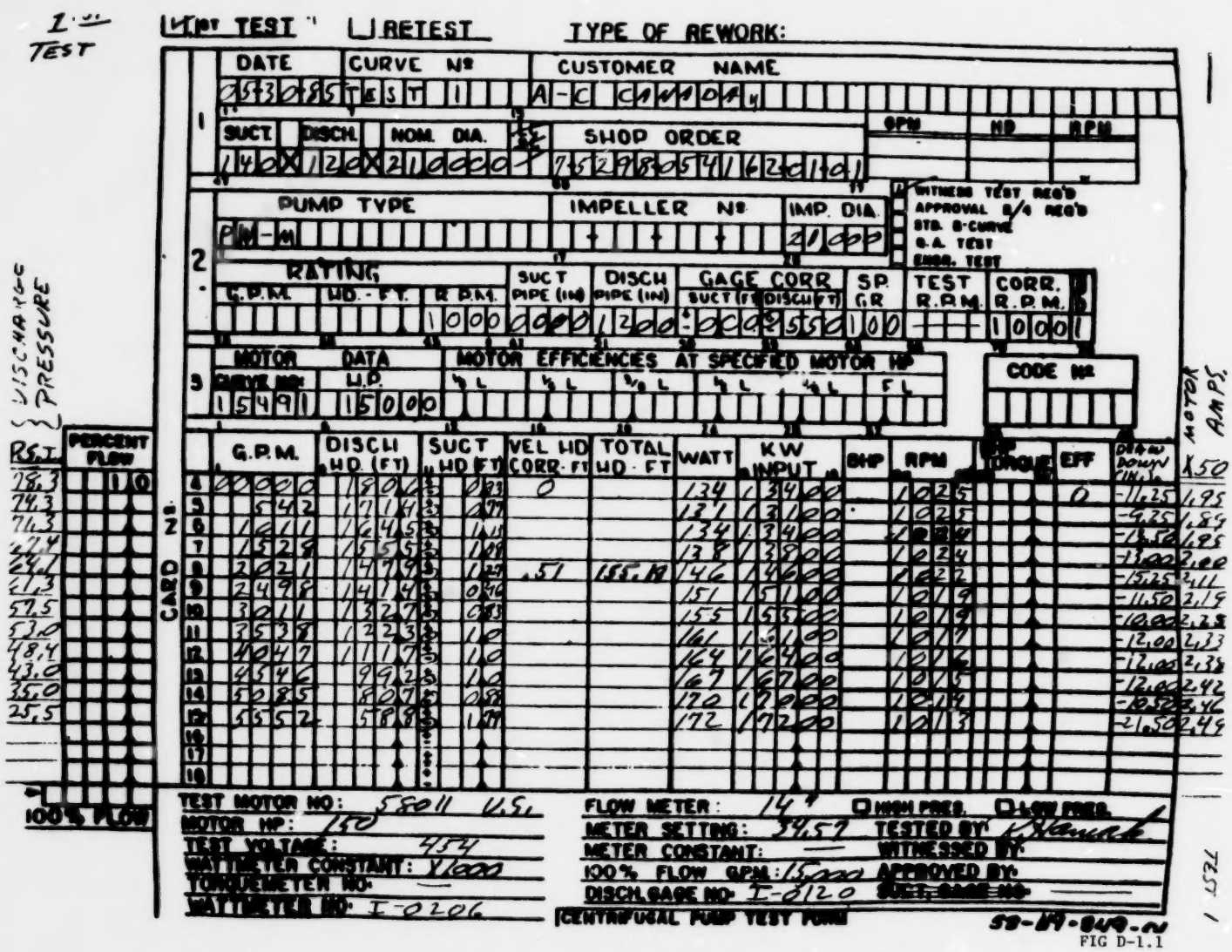
K·E 10 X 10 TO ½ INCH 7 X 10 INCHES
KEUFFEL & ESSER CO.




CURVE A-6536-2
PUMP 10 X 8 X 21 CW
SPEED VAR RPM
IMPELLER DATA
IMP NO P-1184-102
NO OF VANES 3
MAX DIA. 21"
MIN DIA.
MAX. SPHERE 3 3/4"
INLET AREA 78.5 □"
1100 A
1000 B
900 C
800 D
700 E
600 F
500 G
400 H
65
75
78
80
81
80
25
12 NPSH REQ (FT)
21 SUCTION LIFT (FT)
TOTAL HEAD IN FEET
BHP
A
B
C
D
E
F
G
H
A-6536-2
1000
2000
3000
4000
5000
U.S. GALLONS PER MINUTE

APPENDIX D

Allis-Chalmers Pump/Macerator
Shop Tests Data and Performance Characteristics



RS.I.	PERCENT FLOW	G.P.M.	DISCH HD (FT)	SUCT HD FT	VEL HD CORR. FT	TOTAL HD. FT	WATT	KW INPUT	BHP	RPM	EFF	DRAW DOWN FT.	X50
18.3	10	00000	18026	0023	0		134	13400		10255	0	-11.25	1.95
14.3		15442	17141	0077			131	13100		10255		-9.25	1.85
14.3		16111	16465	1411			134	13400		10254		-13.50	1.85
12.4		15288	15555	1008			138	13800		10244		-13.00	2.00
24.1		20211	14795	1023	.51	155.12	146	14600		10222		-15.25	2.11
21.3		24988	14147	0946			151	15100		10219		-11.50	2.19
57.5		30111	13277	0903			155	15500		10219		-10.00	2.25
53.0		35338	12233	1010			161	16100		10217		-12.00	2.33
48.4		40477	11117	1010			164	16400		10216		-12.00	2.38
43.0		45466	9923	1010			167	16700		10216		-12.00	2.42
35.0		50855	8077	0958			170	17000		10214		-10.50	2.46
25.5		55552	5888	1011			172	17200		10213		-21.50	2.49
	100% FLOW												

VISCOSITY
PRESSURE

1

DATE 5-30-85 CUSTOMER A-C CANADA 14. X 12. X 21. -
CURVE NO. TEST #1 ORDER NO. 7-5298-054162-01-01 PW-M
IMP. NO. - - -
IMP. DIA. 21.000

RATING- GPM 0.0 HD.FT. 0.0 RPM 1000.0

	GPM	DISH. HD.	SUCT. HD.	VEL. HD.	TOTAL HD.	KW-INPUT	BHP	EFF.
1	0.0	180.6	-.9	0.00	187.00	134.00	167.62	0.000
2	542.0	171.4	-.7	.04	177.64	131.00	164.01	.148
3	1011.0	164.5	-1.1	.13	171.23	134.00	167.62	.261
4	1528.0	155.5	-1.0	.30	162.30	138.00	172.42	.363
5	2021.0	147.9	-1.2	.52	155.12	146.00	181.94	.435
6	2498.0	141.4	-.9	.80	148.60	151.00	187.99	.494
7	3011.0	132.7	-.8	1.14	140.16	155.00	192.62	.550
8	3538.0	122.3	-1.0	1.60	130.40	161.00	199.67	.592
9	4047.0	111.7	-1.0	2.07	120.23	164.00	203.19	.605
10	4548.0	99.2	-1.0	2.64	108.34	167.00	206.69	.602
11	5085.0	87.7	-.8	3.30	90.30	170.00	210.17	.552
12	5552.0	58.9	-1.7	3.93	69.93	172.00	212.49	.461

TEST DATA--SPEED CORRECTED

	GPM	TOTAL HD.	BHP	EFF.
1	0.0	177.99	155.65	0.000
2	526.8	169.00	152.30	.149
3	987.3	163.30	156.11	.281
4	1492.2	154.78	160.58	.363
5	1977.5	145.51	170.46	.435
6	2451.4	143.11	177.58	.494
7	2954.9	134.98	182.04	.551
8	3478.9	126.07	189.92	.589
9	3983.3	116.53	193.73	.605
10	4478.8	105.16	197.65	.602
11	5014.8	87.82	201.59	.552
12	5480.7	68.15	204.42	.461

FULL LOAD HP 225.00

TEST MOTOR NO. 58011 MOTOR EFF. 1/8 L .890 1/2 L .942
MOTOR CURVE NO. D-1549-1 1/4 L .933 3/4 L .933
MOTOR RATED HP 150.00 3/8 L .942 F.L. .918 MOTOR RPM

SUCT. PIPE 0.00 SUCT. GAGE CORR. 0.00 SP. GR. 1.00 TEST RPM 0.0
DISH. PIPE 12.00 DISH. GAGE CORR. 5.50 TEST CODE CORR. RPM 1000.0

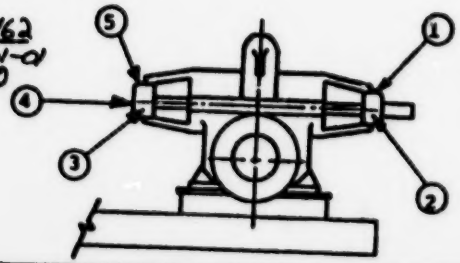
* * * * *

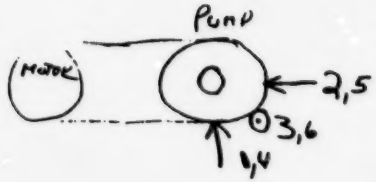
FIG D-1.2

SHOP ORDER: 7-5298-054162-01-01

PUMP SIZE: 14X12X21.0

RATING: _____ GPM
_____ FT
_____ RPM





TESTED BY: TFH

DATE: 5-30-85

VIBRATION READINGS

FLOWRATE	0 GPM		546 GPM		1011 GPM		1521 GPM		2021 GPM		2493 GPM		3011 GPM		3530 GPM	
IRD POSITION	FILTERED @ 1025 RPM	UNFILTERED	FILTERED @ 1025 RPM	UNFILTERED	FILTERED @ 1024 RPM	UNFILTERED	FILTERED @ 1034 RPM	UNFILTERED	FILTERED @ 1022 RPM	UNFILTERED	FILTERED @ 1019 RPM	UNFILTERED	FILTERED @ 1019 RPM	UNFILTERED	FILTERED @ 1012 RPM	UNFILTERED
1	.025	.4	.003	.005	.003	.005	.003 (.025)	.005	.003 (.025)	.005	.01 (.025)	.05	.008 (.025)	.04	.02 (.033)	.13
2	.035	.35	.10	.375	.03	.35	.003	.005	.05	.28	.015	.25	.04	.2	.003	.005
3	.003	.005	.003	.005	.003	.005	.01	.18	.003	.005	.02	.15	.01	.14	.01	.12
4	.45	.3	.003	.005	.003	.005	.003	.005	.003	.00	.20	.35	.14	.65	.38	1.6
5	.23	3	1.2	2.7	.5	2.5	.003	.005	.9	1.8	.25	1.8	.8	1.6	.003	.005
6	.01	.015	.003	.005	.003	.005	.005	2.0	.003	.005	.5	2.2	.2	2.0	.16	1.6

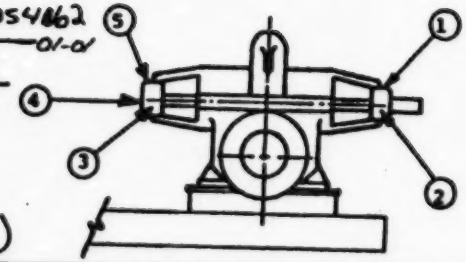
TEST 1

FIG D-1.3

SHOP ORDER: 7-5298-054862 01-01

PUMP SIZE: 14X12X21

RATING: _____ GPM
_____ FT
_____ RPM



TOP VIEW

TESTED BY: TFH

DATE: 5-30-85

CANADA (ALLIS-CHALMERS)

VIBRATION READINGS

FLOWRATE	4644 GPM		4542 GPM		5074 GPM		5554 GPM		____ GPM		____ GPM		____ GPM		____ GPM	
IRD POSITION	FILTERED @ 1016 RPM	UNFILTERED	FILTERED @ 1015 RPM	UNFILTERED	FILTERED @ 1014 RPM	UNFILTERED	FILTERED @ 1013 RPM	UNFILTERED	FILTERED @ RPM	UNFILTERED	FILTERED @ RPM	UNFILTERED	FILTERED @ RPM	UNFILTERED	FILTERED @ RPM	UNFILTERED
1	(625) .02	.12	(625) .003	.005	(625) .007	.005	(625) .003	.005								
2	.045	.20	.003	.005	.035	.20	.035	.18								
3	.035	.08	.003	.005	.003	.005	.003	.005								
4	.35	.80	.003	.005	.003	.005	.003	.005								
5	.69	1.8	.003	.005	.4	2.0	.4	1.8								
6	.55	1.0	.003	.005	.003	.005	.003	.005								

TEST

FIG D-1.4

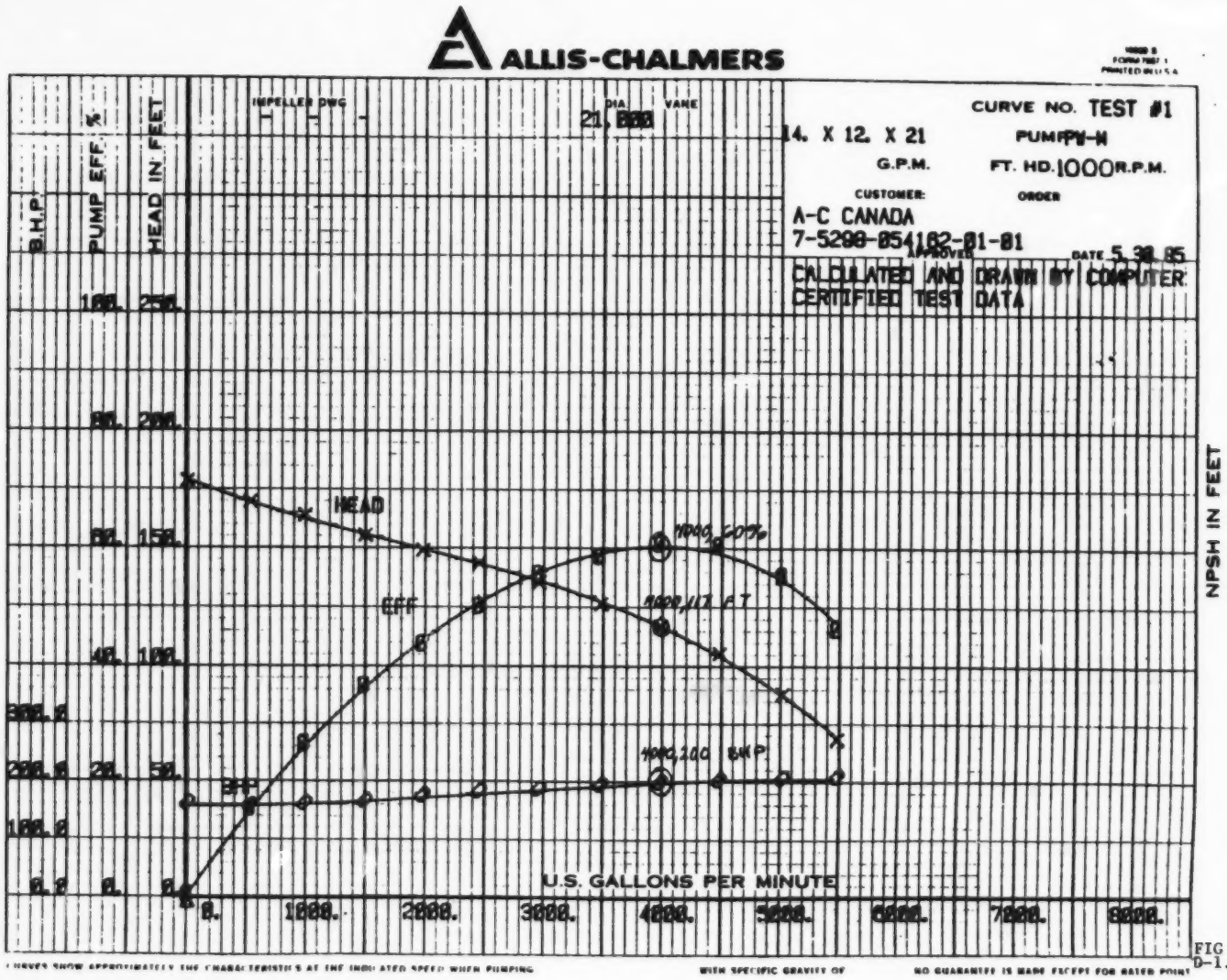

ALLIS-CHALMERS
CURVE NO. TEST #1
14. X 12. X 21
PUMP PU-H
G.P.M.
FT. HD. 1000 R.P.M.
CUSTOMER:
ORDER
A-C CANADA
7-5298-854182-01-81
APPROVED
DATE 5-30-85
CALCULATED AND DRAWN BY COMPUTER
CERTIFIED TEST DATA
IMPELLER DWG
DIA
VANE
21.
B.H.P.
PUMP EFF. %
HEAD IN FEET
NPSH IN FEET
HEAD
EFF
BHP
1000 GPM
80%
1000 FT
1000 GPM
BHP
U.S. GALLONS PER MINUTE
0.
1000.
2000.
3000.
4000.
5000.
6000.
7000.
8000.
CURVES SHOW APPROXIMATELY THE CHARACTERISTICS AT THE INDICATED SPEED WHEN PUMPING
WITH SPECIFIC GRAVITY OF
NO GUARANTEE IS MADE EXCEPT FOR RATED POINT

FIG D-1.5

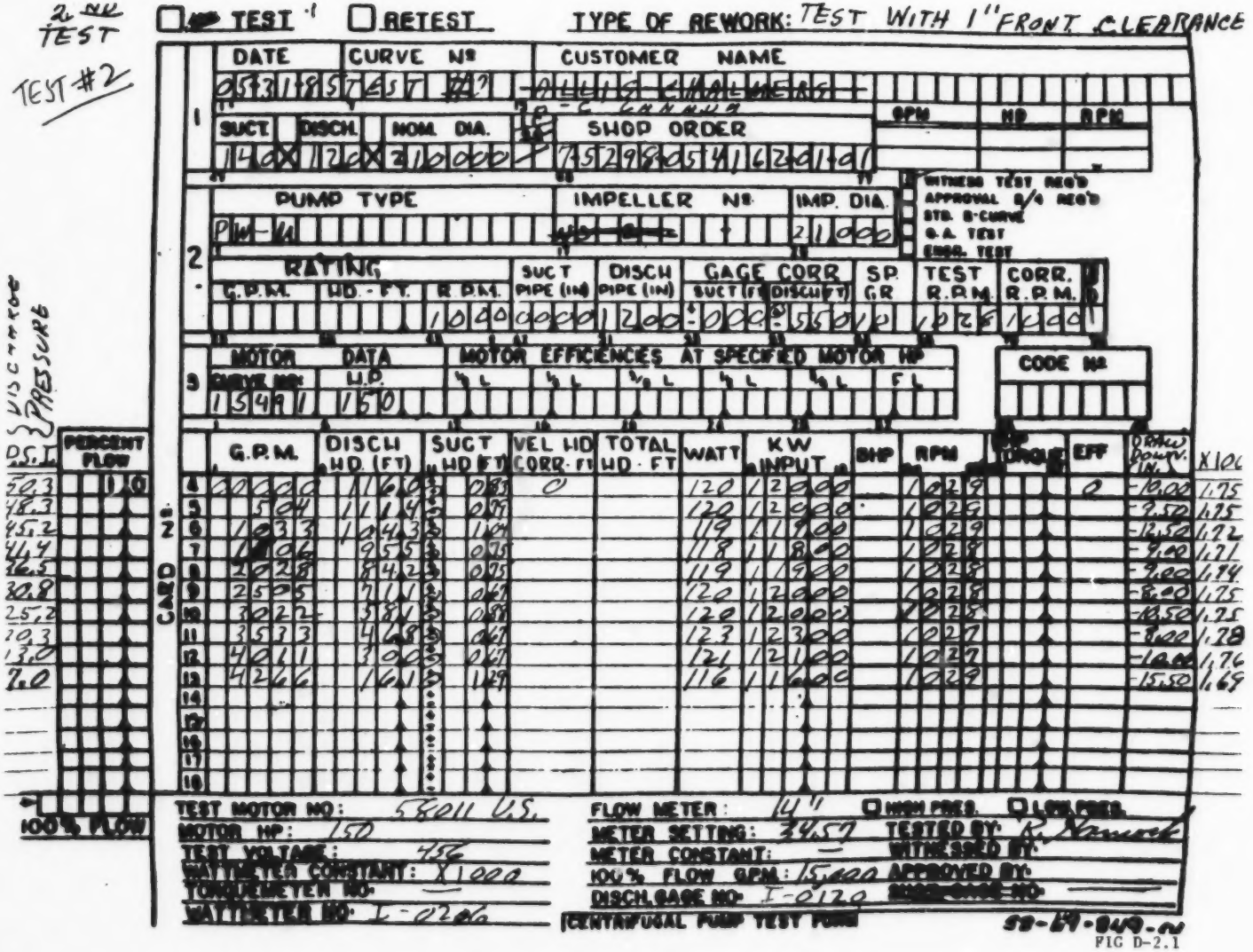


FIG D-2.1

TEST #2

1

DATE 5-31-85 CUSTOMER A-C CANADA 14. X 12. X 21. -
CURVE NO. TEST 82 ORDER NO. 7-5298-054162-01-01 PW-H
IMP. NO. - - - IMP. DIA. 21.000

RATING- GPM 0.0 HB.FT. 0.0 RPM 1000.0

	GPM	DISH. HD.	SUCT. HD.	VEL. HD.	TOTAL HD.	KW-INPUT	BHP	EFF.
1	0.0	116.0	-.8	0.00	122.30	120.00	150.68	0.000
2	504.0	111.4	-.7	.03	117.63	120.00	150.68	.099
3	1033.0	104.3	-1.0	.14	110.94	119.00	149.47	.194
4	1506.0	95.5	-.7	.29	101.99	118.00	148.25	.262
5	2028.0	84.2	-.7	.52	90.92	119.00	149.47	.312
6	2505.0	71.1	-.6	.80	78.00	120.00	150.68	.327
7	3022.0	58.1	-.8	1.17	65.57	120.00	150.68	.332
8	3533.0	46.6	-.8	1.59	54.49	123.00	154.33	.315
9	3533.0	46.8	-.6	1.59	54.49	123.00	154.33	.315
10	4011.0	30.0	-.6	2.05	38.15	121.00	151.90	.254

TEST DATA—SPEED CORRECTED

	GPM	TOTAL HD.	BHP	EFF.
1	0.0	115.50	138.30	0.000
2	489.8	111.10	138.30	.099
3	1003.9	104.77	137.18	.194
4	1465.0	96.51	136.46	.262
5	1972.8	86.04	137.58	.312
6	2436.8	73.81	138.70	.327
7	2939.7	62.04	138.70	.332
8	3440.1	51.66	142.48	.315
9	3440.1	51.66	142.48	.315
10	3905.6	36.17	140.23	.254

FULL LOAD HP 225.00

TEST MOTOR NO. 58011 MOTOR EFF. 1/8 L .890 1/2 L .942
MOTOR CURVE NO. D-1549-1 1/4 L .933 3/4 L .933
MOTOR RATED HP 150.00 3/8 L .942 F.L. .918 MOTOR RPM 1000

SUCT. PIPE 0.00 SUCT. GAGE CORR. 0.00 SP. GR. 1.00 TEST RPM 1028.0
DISH. PIPE 12.00 DISH. GAGE CORR. 5.50 TEST CODE CORR. RPM 1000.0

FIG D-2.2

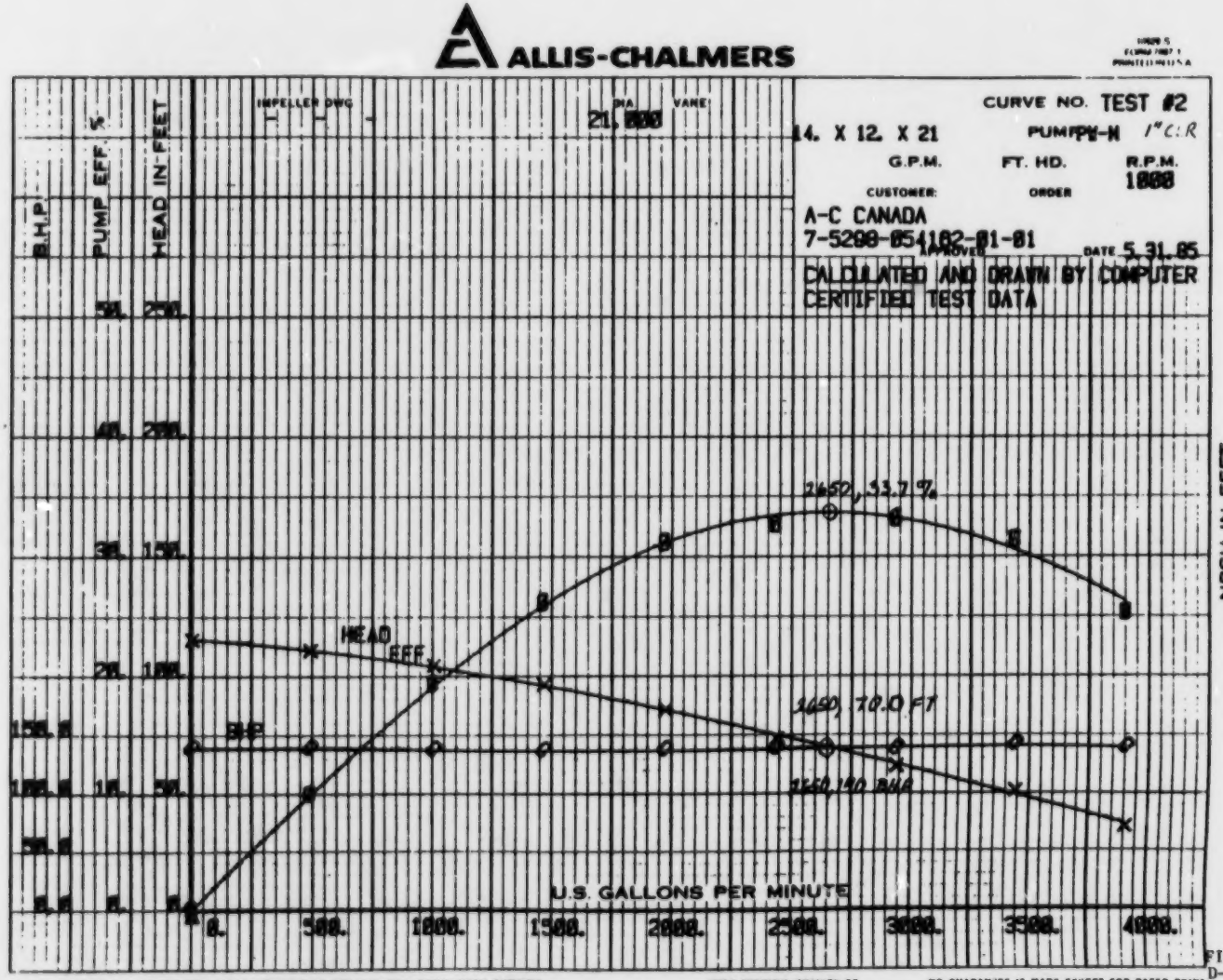

ALLIS-CHALMERS
CURVE NO. TEST #2
14. X 12. X 21
PUMP H
1 STG R
G.P.M.
FT. HD.
R.P.M.
1800
CUSTOMER:
ORDER
A-C CANADA
7-5200-854182-01-01
APPROVED
DATE 5.31.85
CALCULATED AND DRAWN BY COMPUTER
CERTIFIED TEST DATA
IMPELLER DWG
DIA
VANE
21.000
B.H.P.
PUMP EFF. %
HEAD IN FEET
NPSH IN FEET
2650, 53.7 %
HEAD
EFF
1650, 70.0 FT
B.H.P.
1650, 140 BHP
U.S. GALLONS PER MINUTE
0.
500.
1000.
1500.
2000.
2500.
3000.
3500.
4000.
CURVES SHOW APPROXIMATELY THE CHARACTERISTICS AT THE INDICATED SPEED WHEN PUMPING
WITH SPECIFIC GRAVITY OF
NO GUARANTEE IS MADE EXCEPT FOR RATED POINT

FIG D-2.3

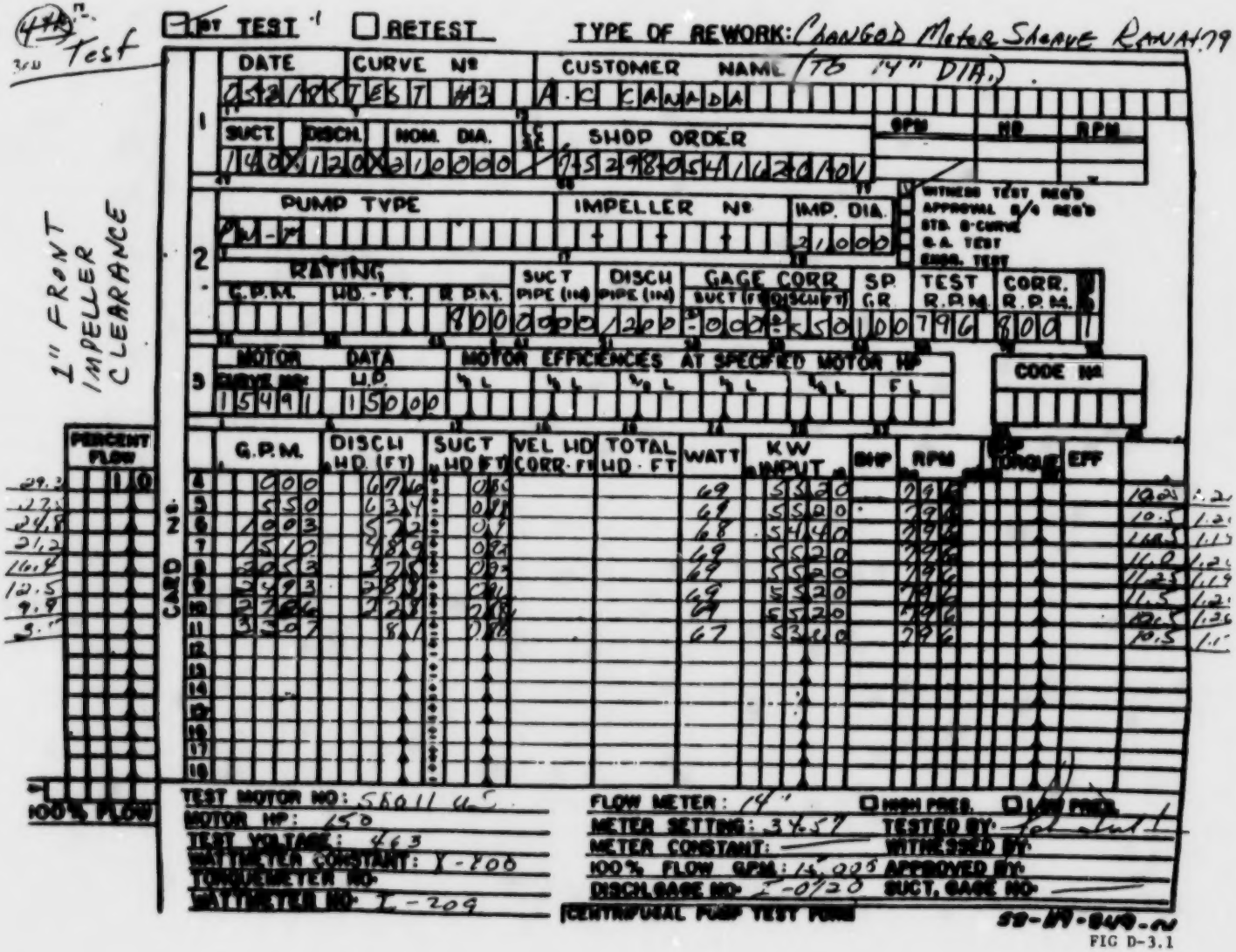

1ST TEST
RETEST
TYPE OF REWORK: Changed Motor Sheave Ratio
DATE
CURVE Nº
CUSTOMER NAME
SUCT.
DISCH.
NOM. DIA.
SHOP ORDER
GPM
HD
RPM
PUMP TYPE
IMPELLER Nº
IMP. DIA.
WITNESS TEST REQ'D
APPROVAL S/O REQ'D
STD. B-CURVE
B.A. TEST
ENGR. TEST
RATING
C.P.M.
HD. - FT.
R.P.M.
SUCT PIPE (IN)
DISCH PIPE (IN)
GAGE CORR
SUCT (FT)
DISCH (FT)
SP. GR
TEST R.P.M.
CORR. R.P.M.
MOTOR DATA
CURVE NO:
H.D.
MOTOR EFFICIENCIES AT SPECIFIED MOTOR HP
CODE Nº
1" FRONT IMPELLER CLEARANCE
CARD
PERCENT FLOW
G.P.M.
DISCH HD (FT)
SUCT HD FT
VEL HD CORR. FT
TOTAL HD. FT
WATT
KW INPUT
BHP
RPM
TORQUE
EFF
29.2
27.3
24.8
21.2
16.4
12.5
9.9
5.1
100% FLOW
TEST MOTOR NO: 58011 45
MOTOR HP: 150
TEST VOLTAGE: 463
WATTMETER CONSTANT: 1-206
TORQUEMETER NO:
WATTMETER NO: 1-209
FLOW METER: 14"
HIGH PRES.
LOW PRES.
METER SETTING: 34.57
TESTED BY:
METER CONSTANT:
WITNESSED BY:
100% FLOW GPM: 14,005
APPROVED BY:
DISCH. GAGE NO: 1-0128
SUCT. GAGE NO:
CENTRIFUGAL PUMP TEST FORM
58-MP-640-N

FIG D-3.1

#3

RATING- RPM 1.0 IMP. 1.0 RPM 1781.1

	GPM	DISH. HD.	SUCT. HD.	VEL. HD.	TOTAL HD.	NPSH	BHP	EFF.
1	0.0	67.6	.8	1.90	72.30	55.20	69.47	0.000
2	550.0	63.4	.8	.04	68.14	55.20	69.47	.106
3	1003.0	57.2	.9	.13	61.93	54.40	68.40	.229
4	1510.0	48.9	.9	.29	53.79	55.20	69.47	.295
5	2053.0	37.8	.9	.54	42.94	55.20	69.47	.320
6	2493.0	28.8	.9	.79	34.19	55.20	69.47	.310
7	2786.0	22.8	.8	.99	28.49	55.20	69.47	.289
8	3307.0	8.1	.8	1.40	14.20	50.60	67.40	.176

TEST DATA--SPEED CORRECTED

	GPM	TOTAL HD.	BHP	EFF.
1	0.0	73.03	70.52	0.000
2	552.8	68.33	70.52	.136
3	1008.0	62.55	69.47	.229
4	1517.6	54.33	70.52	.295
5	2063.3	43.07	70.52	.320
6	2505.5	34.54	70.52	.310
7	2801.1	28.78	71.57	.289
8	3322.6	14.34	68.42	.176

FULL LOAD HP 225.10

TEST MOTOR NO. 58011 MOTOR EFF. 1.0 L .890 1.2 L .742

MOTOR NAME NO. D-1549-1 1.4 L .783 1.4 L .722

MOTOR RATED HP 150.00 1.6 L .742 1.6 L .718 MOTOR RPM 900

SUCT. PIPE 8.00 SUCT. GAGE DIFF. 0.10 SP. GR. 1.00 TEST RPM 776.0

DISH. PIPE 10.02 DISH. GAGE DIFF. 5.50 TEST SIZE DISP. RPM 780.1

FIG D-3.2

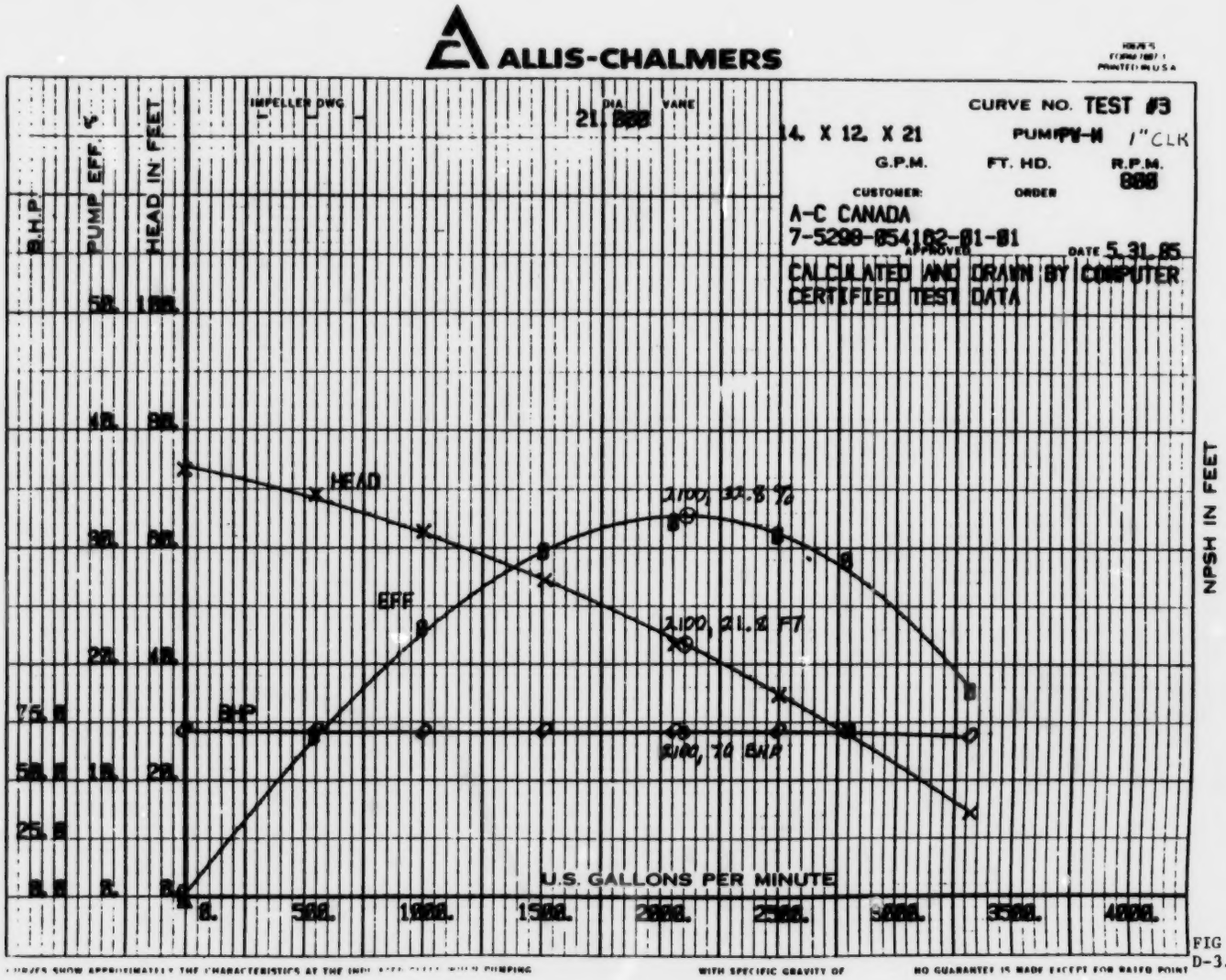

ALLIS-CHALMERS
CURVE NO. TEST #3
14. X 12. X 21
PUMP 14-H 1"CLR
G.P.M.
FT. HD.
R.P.M.
888
CUSTOMER:
ORDER
A-C CANADA
7-5298-854182-81-81
APPROVED
DATE 5.31.85
CALCULATED AND DRAWN BY COMPUTER
CERTIFIED TEST DATA
IMPELLER DWG
21.888 DIA VANE
B.H.P.
PUMP EFF. %
HEAD IN FEET
NPSH IN FEET
HEAD
EFF
B.H.P
3100, 32.8 %
3100, 21.2 FT
3100, 70 B.H.P
U.S. GALLONS PER MINUTE
0.
500.
1000.
1500.
2000.
2500.
3000.
3500.
4000.

FIG D-3.3

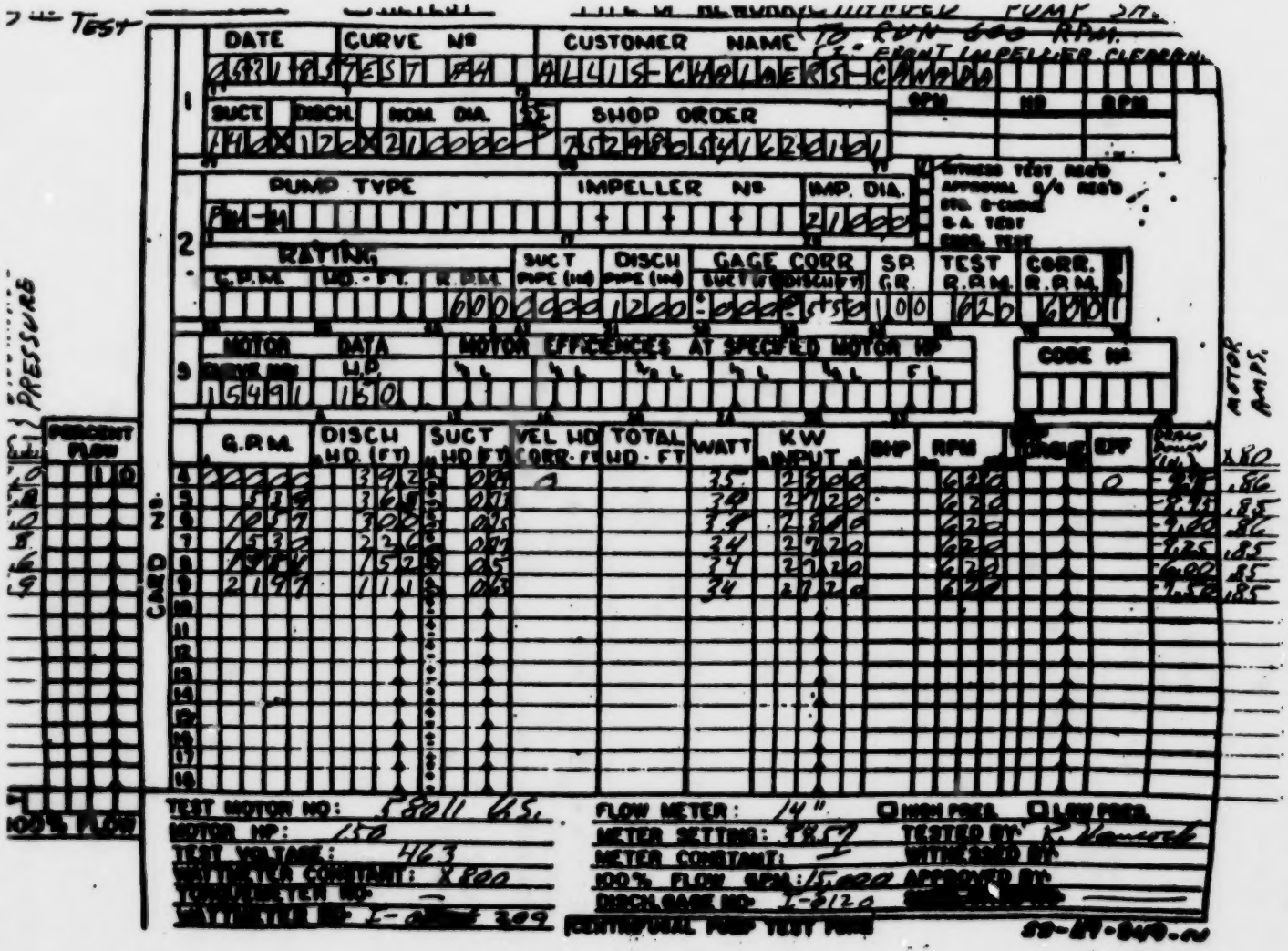


FIG D-4.1

PUMP TEST #4

1

DATE 5-31-65 CUSTOMER A-C CANADA 14. X 12. X 21. -
CURVE NO. TEST 04 ORDER NO. 7-5298-054162-01-01 PW-M
IMP. NO. - - -

IMP. DIA. 21.000

RATING- GPM 0.0 HD.FT. 0.0 RPM 600.0

	GPM	DISH. HD.	SUCT. HD.	VEL. HD.	TOTAL HD.	KW-INPUT	BHP	EFF.
1	0.0	39.2	-.7	0.00	45.4	28.00	33.99	0.000
2	526.0	36.5	-.7	.04	42.74	27.20	32.93	.177
3	1057.0	30.0	-.7	.14	36.34	28.00	33.99	.285
4	1583.0	22.6	-.7	.30	29.10	27.20	32.93	.341
5	1964.0	15.2	-.5	.52	21.70	27.20	32.93	.330
6	2197.0	11.1	-.6	.82	17.82	27.20	32.93	.300

TEST DATA--SPEED CORRECTED

	GPM	TOTAL HD.	BHP	EFF.
1	0.0	42.52	30.31	0.000
2	521.6	40.02	29.05	.177
3	1022.9	34.04	30.31	.285
4	1480.6	27.25	29.05	.341
5	1920.0	20.32	29.05	.330
6	2126.1	16.68	29.05	.300

FULL LOAD HP 225.00

TEST MOTOR NO. 58011 MOTOR EFF. 1/8 L .890 1/2 L .942
MOTOR CURVE NO. D-1549-1 1/4 L .935 3/4 L .933
MOTOR RATED HP 150.00 3/8 L .942 F.L. .918 MOTOR RPM 600

SUCT. PIPE 0.00 SUCT. GAGE CORR. 0.00 SP. GR. 1.00 TEST RPM 620.0
DISH. PIPE 12.00 DISH. GAGE CORR. 5.50 TEST CODE CORR. RPM 600.0

FIG D-4.2

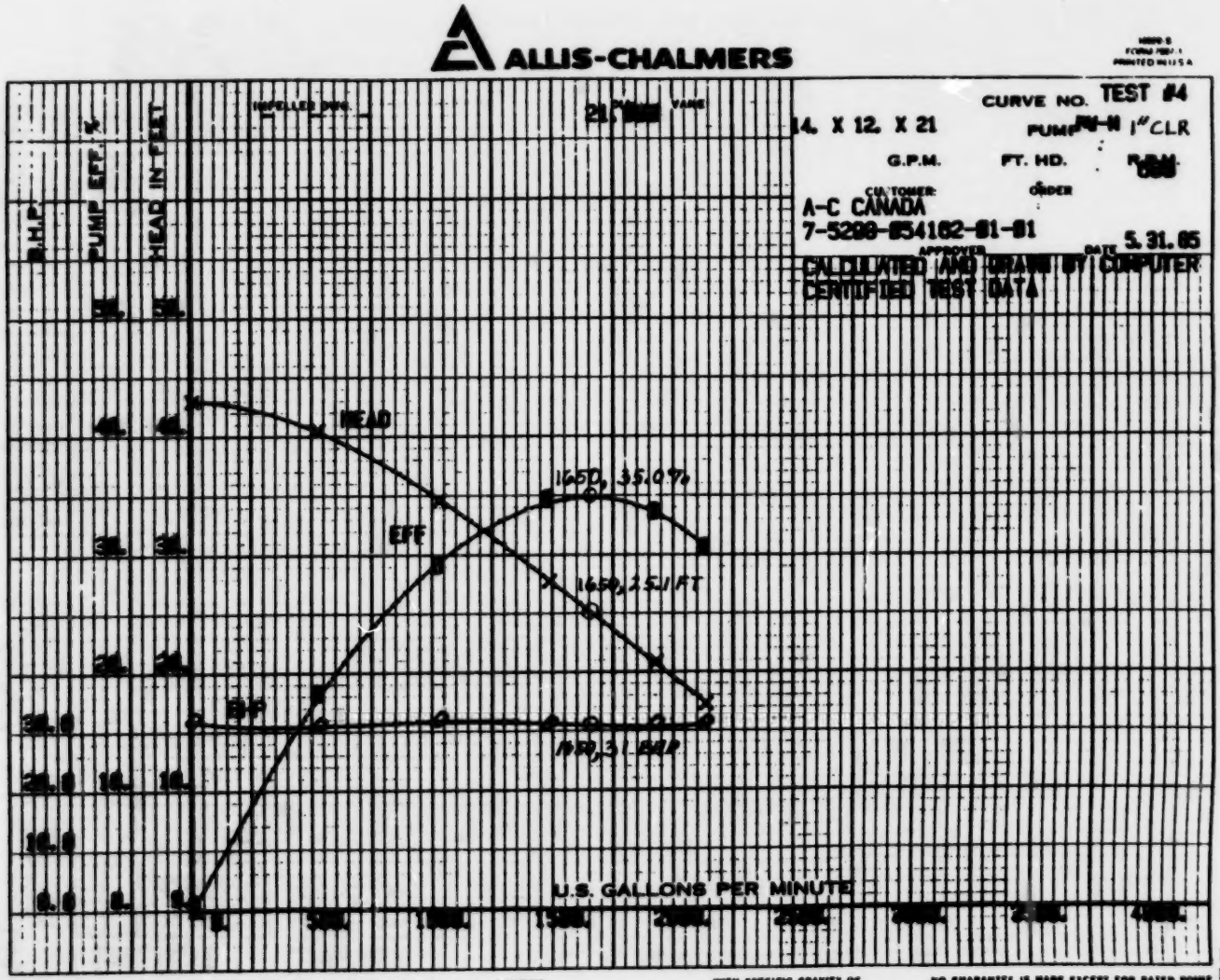

ALLIS-CHALMERS
CURVE NO. TEST #4
14. X 12. X 21
PUMP FM-M 1"CLR
G.P.M.
FT. HD.
R.P.M.
CUSTOMER
A-C CANADA
ORDER
7-5298-854182-81-81
APPROVED
DATE 5.31.85
CALCULATED AND DRAWN BY COMPUTER
CERTIFIED TEST DATA
B.H.P.
PUMP EFF. %
HEAD IN FEET
NPSH IN FEET
HEAD
EFF
BHP
1650, 35.07%
1650, 251 FT
U.S. GALLONS PER MINUTE

FIG D-4.3

PUMP TEST #5

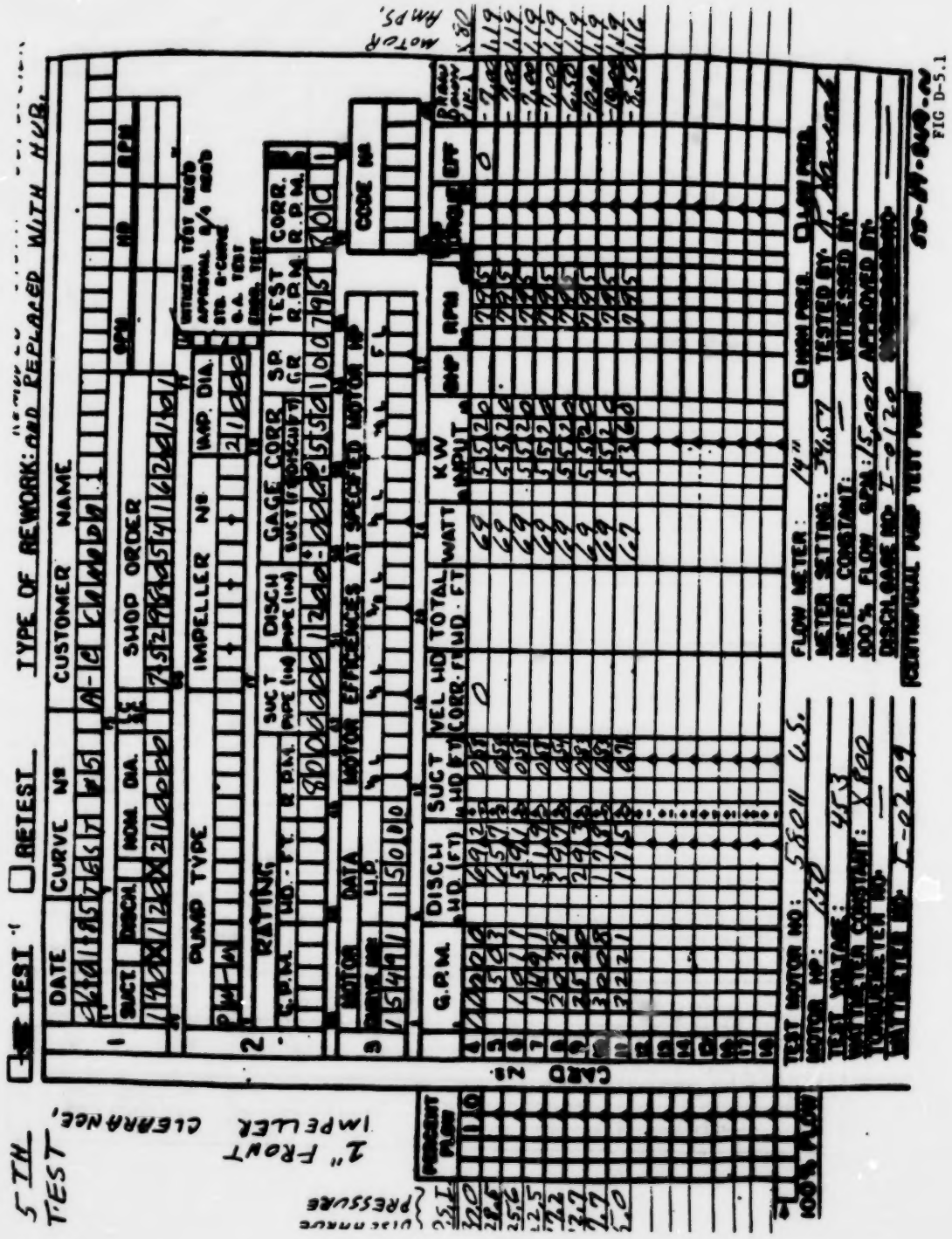


FIG D-5.1

1

DATE 6- 1-85 CUSTOMER A-C CANADA 14. X 12. X 21. -
CURVE NO. TEST 85 ORDER NO. 7-5298-054162-01-01 PW-M
IMP. NO. - - - IMP. DIA. 21.000

RATING- GPM 0.0 HD.FT. 0.0 RPM 900.0

	GPM	DISH. HD.	SUCT. HD.	VEL. HD.	TOTAL HD.	KW-INPUT	BHP	EFF.
1	0.0	69.2	-.5	0.00	75.20	55.20	69.47	0.000
2	503.0	65.7	-.5	.03	71.73	55.20	69.47	.131
3	1011.0	59.1	-.5	.13	65.23	55.20	69.47	.240
4	1491.0	51.9	-.5	.28	58.18	55.20	69.47	.315
5	2038.0	39.7	-.5	.53	46.23	55.20	69.47	.342
6	2520.0	29.3	-.8	.81	36.41	55.20	69.47	.334
7	3008.0	17.8	-.8	1.15	25.25	55.20	69.47	.276
8	3221.0	11.5	-.7	1.32	19.02	53.60	67.40	.230

TEST DATA--SPEED CORRECTED

	GPM	TOTAL HD.	BHP	EFF.
1	0.0	76.15	70.78	0.000
2	506.2	72.64	70.78	.131
3	1017.4	66.05	70.78	.240
4	1500.4	58.92	70.78	.315
5	2050.8	46.81	70.78	.342
6	2535.6	36.87	70.78	.334
7	3026.4	25.57	70.78	.276
8	3241.3	19.26	68.66	.230

FULL LOAD = 225.00

TEST MOTOR NO. 58[illegible] MOTOR EFF. 1 0 [illegible] .[illegible] 1 2 [illegible] .942
MOTOR CUP [illegible] [illegible] 1/4 [illegible] .[illegible] [illegible] .[illegible]
MOTOR PARTS NO [illegible] 3/4 [illegible] .942 F[illegible] .916 MOTOR EFF [illegible]

SUCT. PIPE 6.0[illegible] SUCT. GAGE DIST. [illegible] [illegible] TEST BHP [illegible]
DISCH. PIPE [illegible] DISCH. GAGE DIST. [illegible] TEST SPEED [illegible] COMP BHP [illegible]

FIG D-5.2

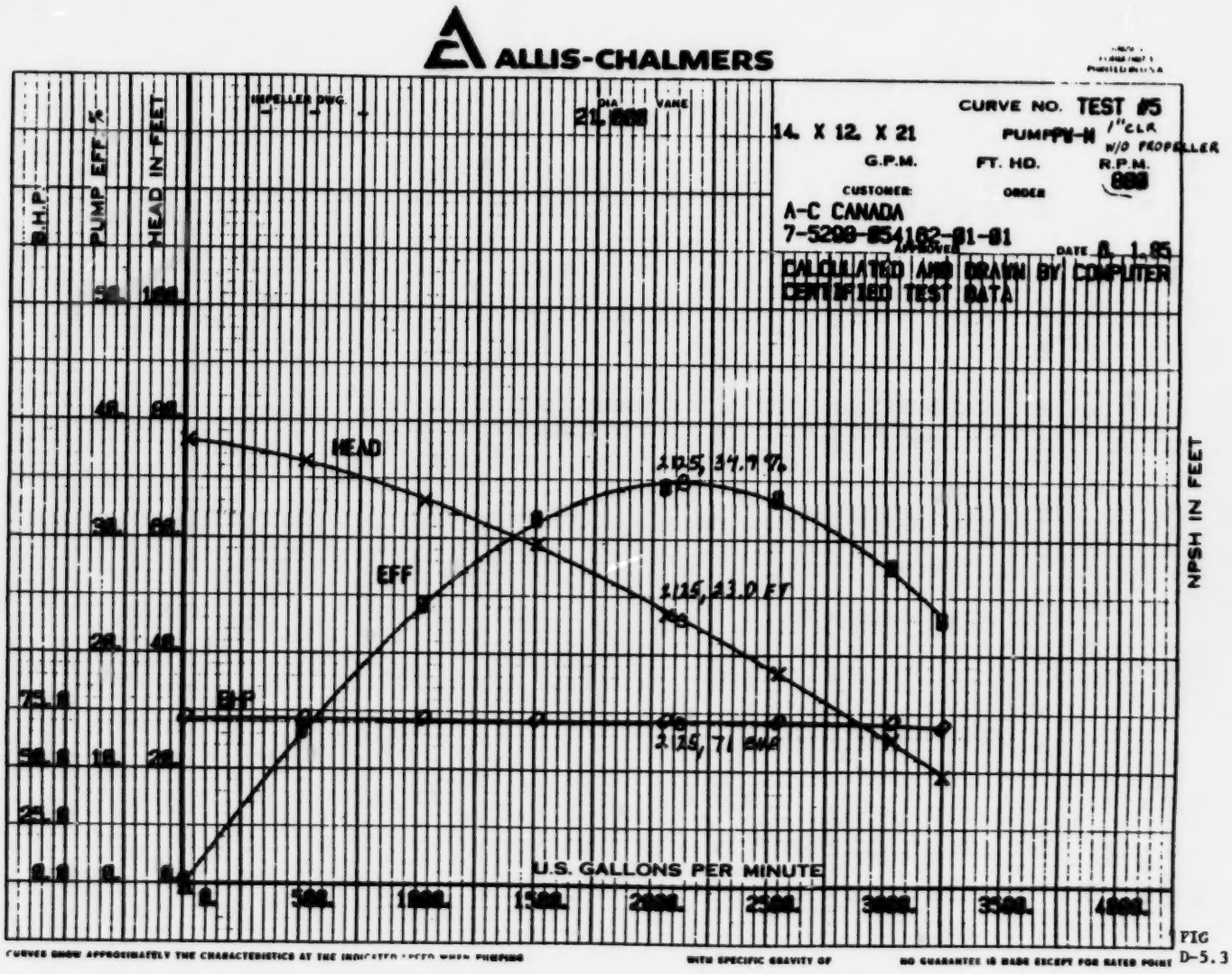

ALLIS-CHALMERS
CURVE NO. TEST #5
14. X 12. X 21
PUMP 14-M
1" CLR.
W/O PROPELLER
G.P.M.
FT. HD.
R.P.M.
CUSTOMER:
ORDER
A-C CANADA
7-5298-854102-81-81
DATE 8. 1.85
CALCULATED AND DRAWN BY COMPUTER
CENTRIFUGO TEST DATA
IMPELLER DWG.
DIA
VANE
21.688
B.H.P.
PUMP EFF %
HEAD IN FEET
NPSH IN FEET
HEAD
EFF
B.H.P.
NPSH
U.S. GALLONS PER MINUTE

FIG D-5.3

APPENDIX E

Minutes of Meetings

1.	October 1, 1984	A Review of the Allis-Chalmers' Proposal of August 17, 1984, to Design, Manufacture and Test a Peat Slurry Macerating Pump
2.	November 16, 1984	A Review of the Allis-Chalmers' Design of Peat Slurry Macerating Pump and Give Approval to Allow Allis-Chalmers to Purchase Casting
3.	January 22, 1985	Design and Progress Review Meeting with Allis-Chalmers
4.	April 12, 1985	Design and Progress Review Meeting with Allis-Chalmers
5.	May 16, 1985	Design and Progress Review Meeting with Allis-Chalmers

A complete copy of Appendix E may be purchased from the Depository of Unpublished Data, Canada Institute for Scientific and Technical Information, National Research Council of Canada, Ottawa, Ontario K1A 0S2.

APPENDIX F

Allis-Chalmers Instruction Manual for Installation,
Operation and Maintenance of Peat Slurry/Macerating Pump

ALLIS-CHALMERS
CANADA INC.

INSTRUCTIONS

FOR

INSTALLATION, OPERATION AND MAINTENANCE

OF

PEAT SLURRY MACERATING PUMP

INTRODUCTION

The information contained in this booklet is intended to assist operation personnel by providing information about the general characteristics of the purchased equipment; it does not relieve the user of the responsibility of using accepted engineering practices during the installation, operation or maintenance of this equipment. For more detailed advice, The Standards of the Hydraulic Institute are an excellent source.

INSTALLATION

(Refer to the general arrangement drawings).

LOCATION OF UNIT

This pump is designed to be mounted on a specially designed raft, (not supplied by Allis-Chalmers) where it is to be supported by its four horizontal legs - or to be hung by special suspender, supplied as a standard accessory with the pump. A clear space should be allowed for an overhead crane hoist or an "A" frame, strong enough to lift the unit, to provide accessibility for maintenance and inspection during operation.

INSTALLATION OF UNIT

1. Before the unit is installed, check all bolts and nuts on the entire unit to be sure they are tight.

2. Hook-up the sleeve bearings lubrication piping. When water is to be used for lubrication, it is advisable to install a strainer and control valve in this line. It is also advisable to install a flow meter in the lubrication line to ensure that the fresh water is continually flowing to the bearings and also to indicate the adequate water pressure due to the bearings wear.

3...Connect discharge pump piping, making certain that piping is securely fastened so that it will not exert any excessive loads and vibration on the pump.

4. Check the water level: the unit should be submerged in the liquid to the minimum level mark (approx. 24" below the base plate). However, the liquid level should not exceed the maximum level mark (approx. 3" below the base plate).

5. Make electrical connections. Check for proper motor rotation before connecting belts. Correct rotation is clockwise looking down. Make certain the power cable is secured so it will not get entangled in the stump deflector rotating at the bottom of the unit.

   Warning: Serious damage to the pump could occur if unit is started with incorrect rotation.

OPERATION

LUBRICATION

The pump is designed so that both, either the water or the light grease can be used for lubrication of the sleeve bearings.
Before starting the pump, turn on the lubricating medium to both, upper and lower sleeve bearings.
The pressure should be 5 to 10 psi greater than the discharge pressure of the pump. This is a requirement, even when the whole pump column is submerged and the pump is not running. The balance between the middle and the lower sleeve bearing lubrication can be controlled by the two valves, located on the base plate of the unit.
When light grease is chosen for sleeve bearings lubrication, all lubrication piping and bearing housings cavities have to be completely filled with grease, with no air pockets, before pump start-up.

Make certain the upper ball bearing housing is appropriately filled with proper grade grease.

START-UP PROCEDURE

With the bearings properly lubricated the pump may now be started. It is advisable to close the discharge valve to near shut-off to reduce the load requirement on the motor.

START-UP PROCEDURE (Cont'd)

Open the valve slowly until the rated capacity is reached. Constantly watch the power required by the motor to make certain it does not become over-loaded. When the pump has reached its rated head and capacity, record the power reading and compare it to the motor nameplate rating.

If the horse-power requirement is high, open more or re-adjust the sleeve bearing lubrication control valves. It is possible for the friction caused by inadequately lubricated bearings, to add horse-power to the motor load.

MAINTENANCE

(Refer to Sectional assembly drawings)

After the pump is running, check and record the power reading, head and capacity plus motor temperature every two hours after start-up. Routine checks on performance should be established during the operation period. At the end of two months and again at four months, dismantle and inspect pump. Check for bearing wear. The special sleeve bearing will stand a certain amount of abrasive wear as long as they are lubricated but, they should be thoroughly inspected for wear.

Also check for proper axial wheel clearance (between axial wheel and static knife and between axial wheel and forwarding guide). The maximum clearance on each side of axial wheel should not exceed .040" and must not be smaller than .010" Unless the parts are excessively worn, clearance can be adjusted by rearranging the shims between the inner sleeve and axial wheel and between the static knife and forwarding guide.

Before readjusting the axial wheel clearance, the impeller front clearance has to be checked first, and adjusted if desired so. Never readjust the impeller clearance <u>after</u> the axial wheel clearance is set up. This can cause serious damage to the pump.

The impeller front clearance (between impeller and wear plate) should never be less than .030" and should be carefully

MAINTENANCE (Cont'd)

checked when the 1.0" wear plate spacer is installed. With no spacer installed, the impeller front clearance could be adjusted up to the maximum of 1.0" If at the end of the second inspection, the pump appears to be in serviceable condition, the running periods may be extended. If records are kept at each shut-down and repairs noted the optimum running time may be determined from the results of a series of repeated tabulations of performance, wear and life of critical parts.

DISMANTLING PROCEDURE AND INSPECTION:

(Refer to Sectional assembly and general arrangement drawings)

1. Disconnect power source
2. Disconnect discharge piping and sleeve bearings lubrication line.
3. Remove belt guards, remove belts.
4. Unbolt and remove motor from the motor stool.
5. Unbolt unit hold-down fasteners (if applicable).
6. Pull the unit out of the water and place horizontally (watch for accessibility to service door).
7. Unbolt discharge piping at the casing discharge flange.
8. Remove the service door (front right hand side).
9. Disconnect sleeve bearing lubrication piping from stuffing box cover and static knife (at the bottom of the unit).
10. Remove pump sheave.
11. Remove the rubber plug from stump deflector hub, at the bottom of the unit (by squeezing screwdriver between the plug and the hub).
12. Loosen and remove the hex. socket head screw at the bottom end of the shaft c/w washer and two "O" rings.

DISMANTLING PROCEDURE AND INSPECTION: (Cont'd)

13. Remove stump deflector and shaft key (c/w spacer if installed). Check special shaft key for damage.

14. Unbolt and remove static knife (c/w shims if any installed). Inspect static knife sleeve bearing for wear.

15. Remove axial wheel and shaft key (c/w shims if any installed).

16. Unbolt and remove forwarding guide c/w wear plate, remove sleeve spacer.

17. If desired so, unscrew wear plate and wear plate spacer (when installed) from forwarding guide. Inspect wear plate for wear. Inspect forwarding guide sleeve bearing for wear. Unscrew and remove the inner and outer cutting ring, inspect them for wear and damage.

18. Remove impeller spacer, impeller and shaft key.

19. Unbolt and remove pump casing, stuffing box cover and shaft sleeve. Inspect shaft sleeve for wear.

20. Unscrew and remove stuffing box cover end plate, inspect the sleeve bearing for wear.

21. Unscrew and remove bearing housing c/w shaft.

22. Dismantle bearing housing. Inspect bearings for wear and damage. Inspect upper and lower shaft seal. Remove bearings from shaft only when replacement is desired.

23. Inspect the blades edges of forwarding guide, axial wheel and static knife. If the total wear of all three parts is less than .080", the blades edges can be repaired - provide the total reduction of the blades after repair will not exceed .080". The original tolerances for perpendicularity and straightness must be maintained. If the wear is in the excess of .080", the parts have to be replaced.

24. Replace all other parts which were found worn or damaged during the inspection procedure.

REASSEMBLY PROCEDURE

(Refer to Sectional Assembly and General Arrangement drawing).

Generally, assemble the pump in the reverse order of disassembly. Be sure all bolts, locking screws and nuts are properly tightened and all clearances maintained, as specified. To be sure the pump is reassembled correctly, compare it to the assembly drawings.

Particularly, there are two basic styles according to which the pump to be assembled.

Style A: With wear plate spacer up to .75" max. wide installed (impeller clearance .25"-1.00" depending on the spacer size used.) Shimming between the pump casing and forwarding guide is not required. Only the axial wheel clearance must be checked and shims used as described in "Maintenance" section of this booklet.

Style B: With wear plate spacer of 1.00" max. wide installed (impeller min. clearance .030").

After installing the pump casing c/w stuffing box cover, shaft sleeve and impeller, continue to complete the assembly at rotating element only, replacing temporary the axial wheel with the stump deflector spacers (item 27 mark 002 & 003 or mark 001 and 002, and the stump deflector with the hub item 54). After tightening the hex. socket screw (item 35) at the bottom end of the shaft, install the forwarding guide c/w wear plate and wear plate spacer. Adjust the impeller clearance to the desired limit (minimum .030") by shimming between the pump casing and forwarding guide flanges. After the impeller clearance (measured at the impeller blades) is satisfactory, disassemble the bottom end of rotating element, remove the temporary used spacers and install the axial wheel and stump deflector instead. Adjust the axial wheel clearance as described in "Maintenance" section of this booklet. Complete the assembly as per Sectional section and General Arrangement drawings. After the above is completed, install the unit and follow the "start up procedure".

ORDERING PARTS

The pumps discussed in this manual have been designed and built with certain replaceable wearing parts. The recommended inventory of spare parts depends upon the installation and importance of continued operation.

Parts should be ordered as far in advance of their use as possible, because circumstances beyond the control of the company may reduce existing stock. Some parts are not stocked and must be manufactured for each order.

To expedite handling the order for spare parts, be sure to include the following information: -

1. Serial number of the pump;
2. Quantity of each part;
3. Catalog number of the part;
4. Name of part;
5. Material desired. *

* Parts will be furnished in original materials unless specified as a material change. Discuss all material substitutions with the factory. Impellers will be furnished at maximum diameter unless specific diameter is requested on purchase order.

APPENDIX G

Peat Slurry Pump/Macerator
Shop Tests Photos

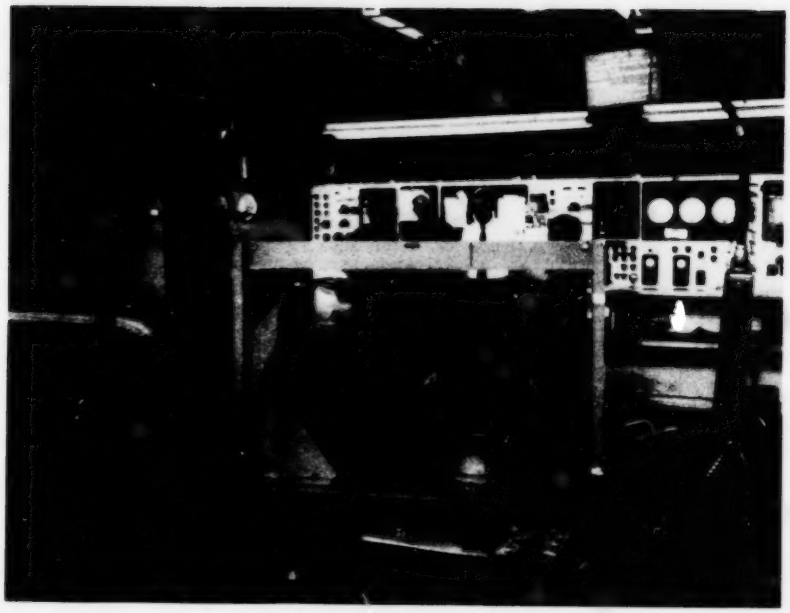


FIG G-1

ALLIS-CHALMERS PUMP TEST FACILITY
WITH PEAT PUMP/MACERATOR AND SHOP
TEST MOTOR IN TEST PIT BEFORE
START OF TEST #1

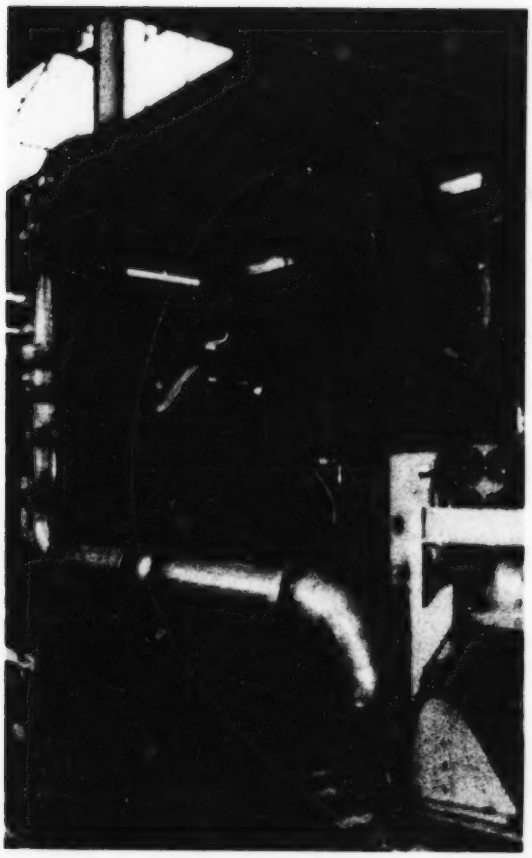


FIG G-2

PUMP TEST DISCHARGE PIPING

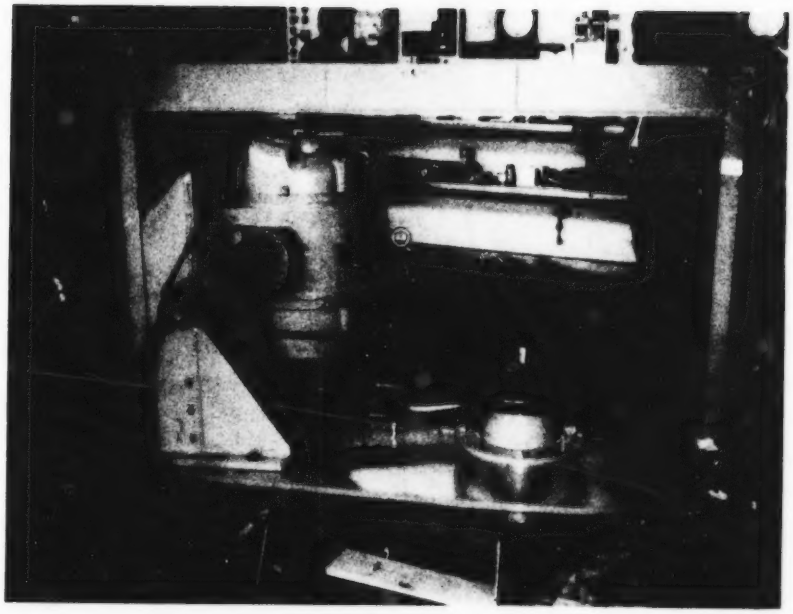


FIG G-3

CLOSE-UP OF PEAT PUMP/MACERATOR DURING TEST #1. NOTE THAT UNIT IS NOT BOLTED DOWN

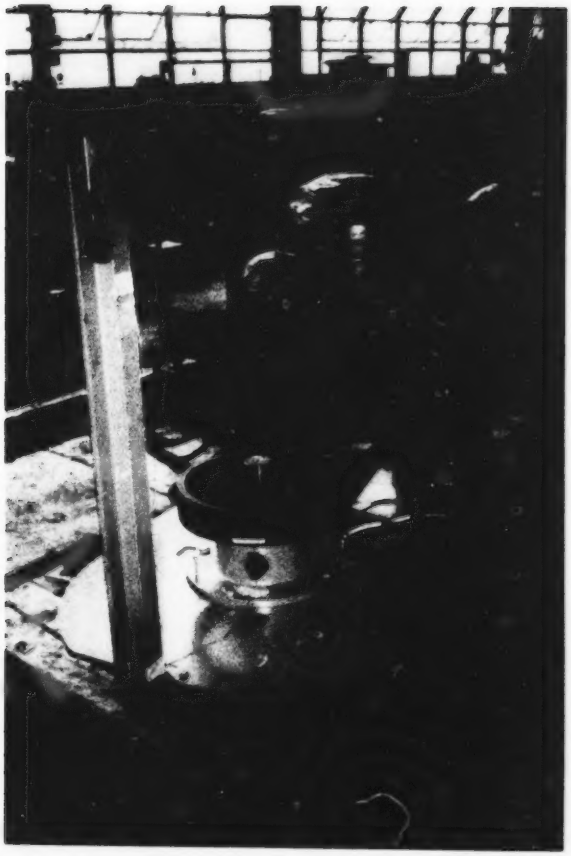


FIG G-4

VIEW OF PEAT PUMP/MACERATOR WITH TEMPERATURE PROBE MOUNTED ON PUMP THRUST BEARING AND DIGITAL TEMPERATURE INDICATOR MOUNTED ON LIFTING BEAM

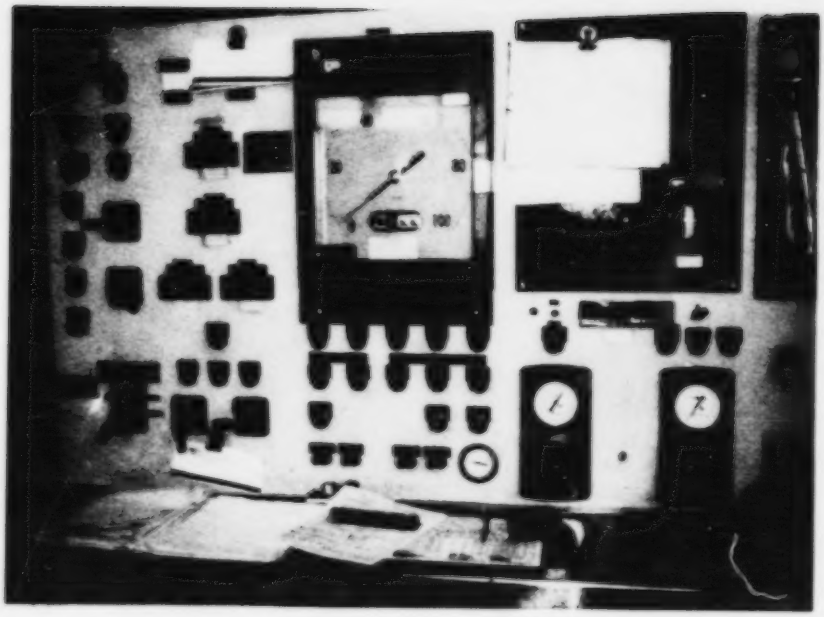


FIG G-5

PUMP TEST PANEL WITH DIGITAL FLOW
MEASUREMENT INDICATOR, DIGITAL
AMMETER AND DIGITAL WATTMETER

FIG G-6

PUMP/MACERATOR SHOP TEST
WITH IRD VIBRATION MONITOR
IN PLACE

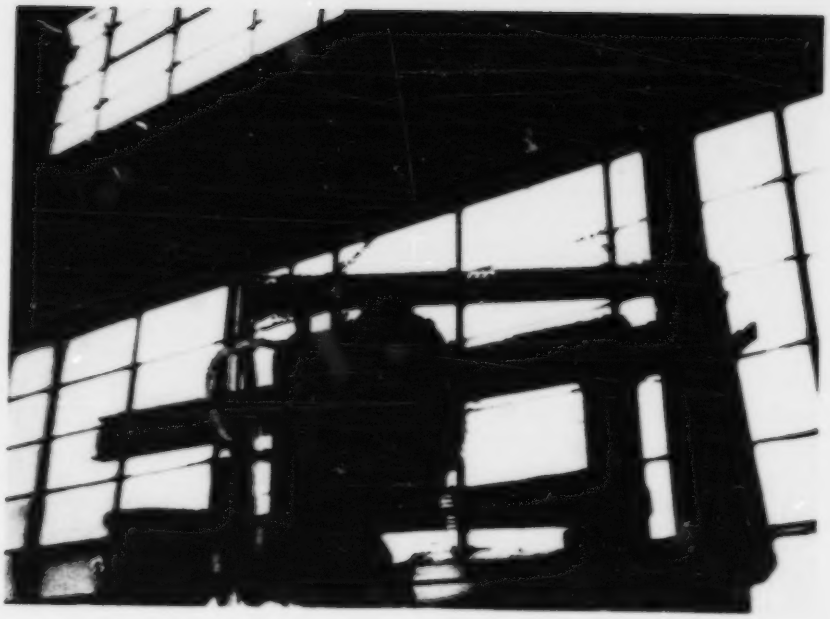


FIG G-7

PEAT PUMP/MACERATOR ASSEMBLY BEING LIFTED OUT OF PUMP TEST PIT AFTER TEST #1. NOTE THAT PUMP/MACERATOR AND MOTOR ASSEMBLY IS EVENLY BALANCED.

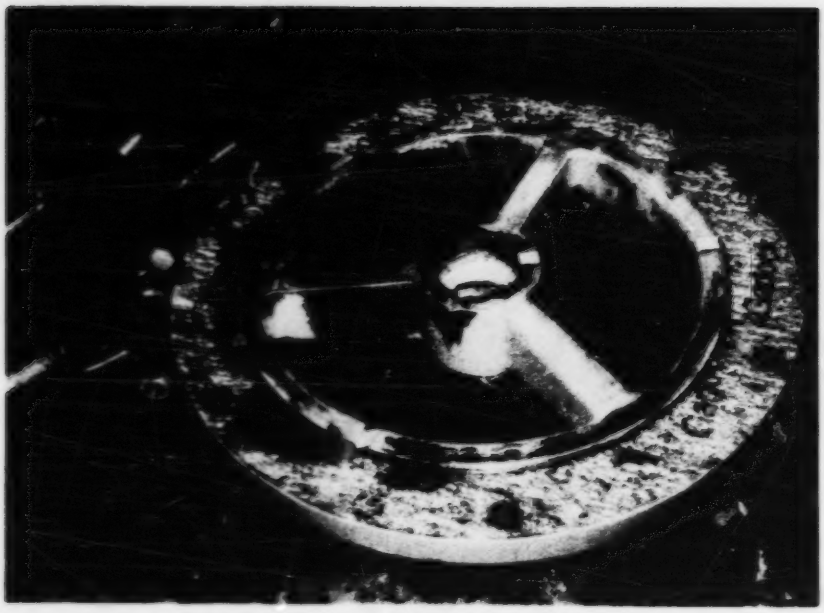


FIG G-8

STATIC KNIFE AFTER TEST #1

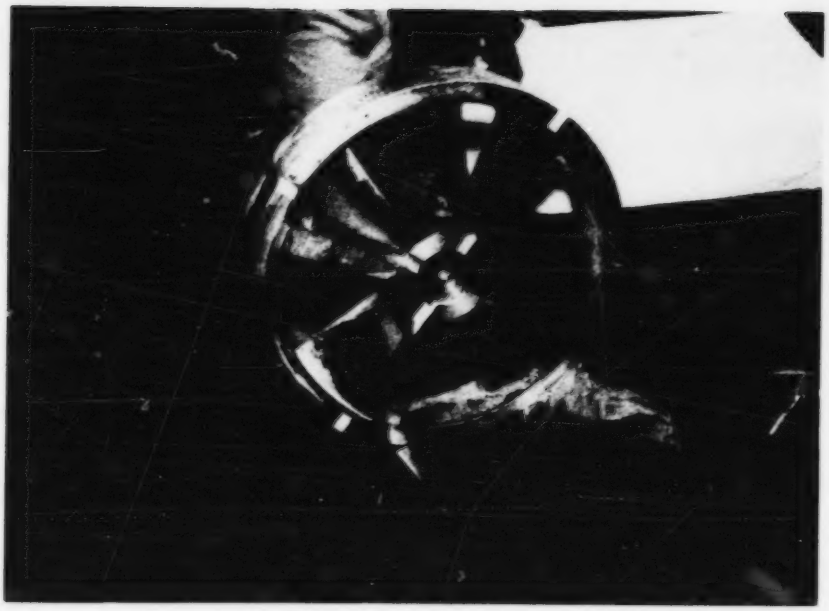


FIG G-9

AXIAL WHEEL AFTER TEST #1

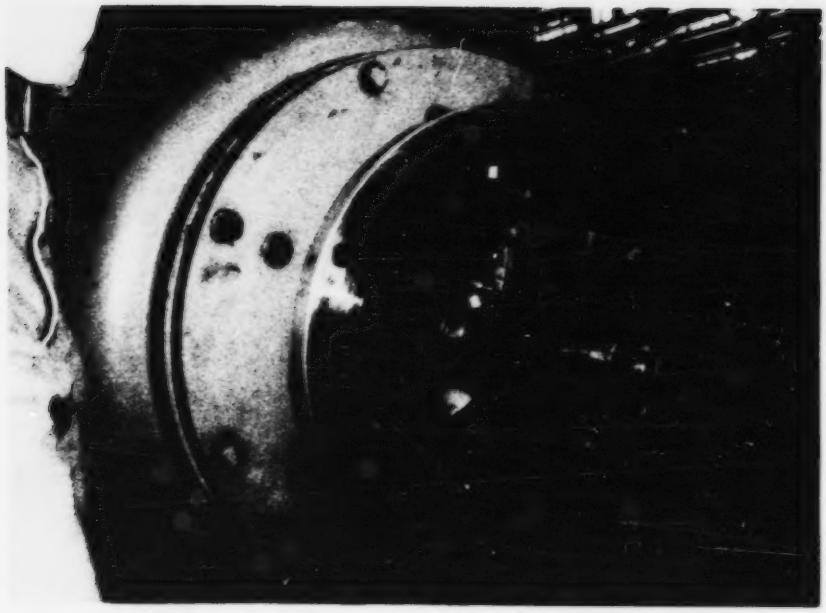


FIG G-10

VIEW OF PEAT PUMP/MACERATOR ASSEMBLY WITH AXIAL WHEEL, STATIC KNIFE AND STUMP DEFLECTOR REMOVED SHOWING FORWARDING GIUDE IN FOREGROUND WITH IMPELLER INLET VANES BEHIND.

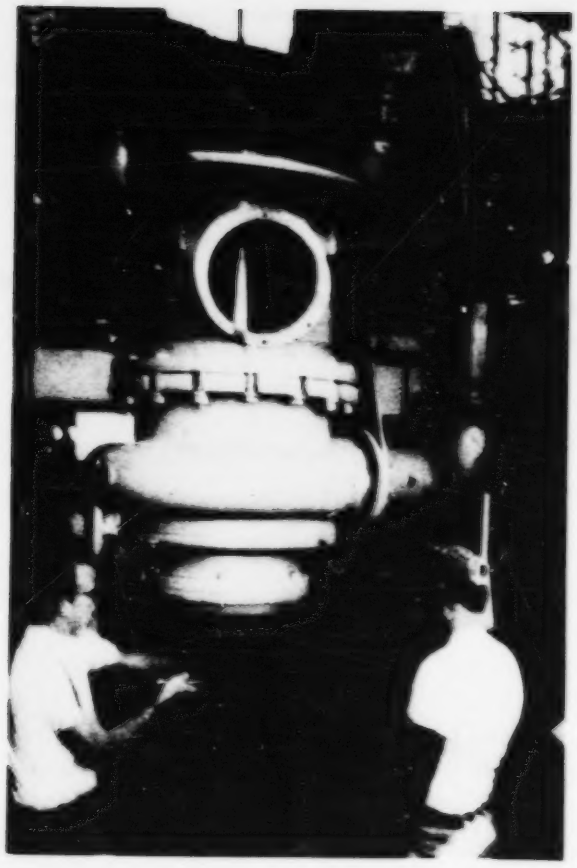


FIG G-11

STUMP DEFLECTOR BEING TEGHTENED BEFORE TEST #2

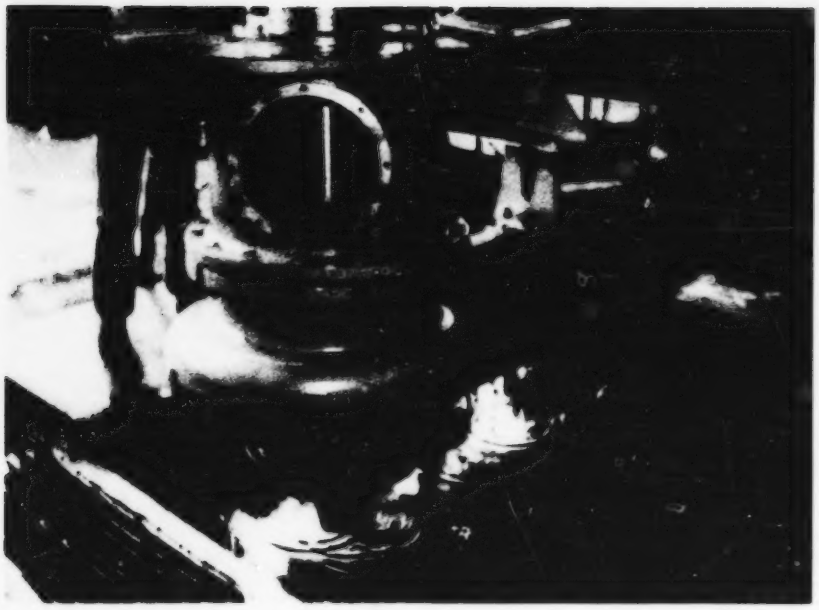


FIG G-12

PEAT PUMP/MACERATOR BEING LOWERED
INTO PUMP TEST PIT FOR TEST #2

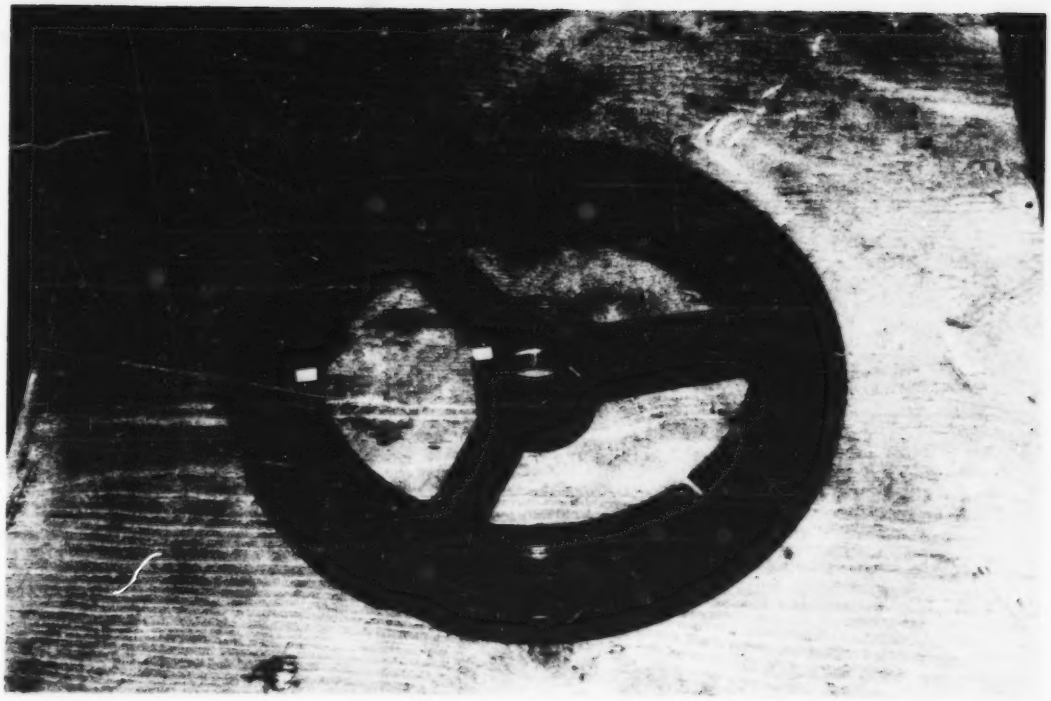


FIG G-13

MACHINED STATIC KNIFE. PLEASE NOTE NOTCHES DESIGNED TO PREVENT PEAT MOSS FROM BINDING BETWEEN STATIC KNIFE AND AXIAL WHEEL. SIMILAR NOTCHES ARE ON AXIAL WHEEL (SEE PHOTO OF AXIAL WHEEL).

FIG G-14

MACHINED AXIAL WHEEL

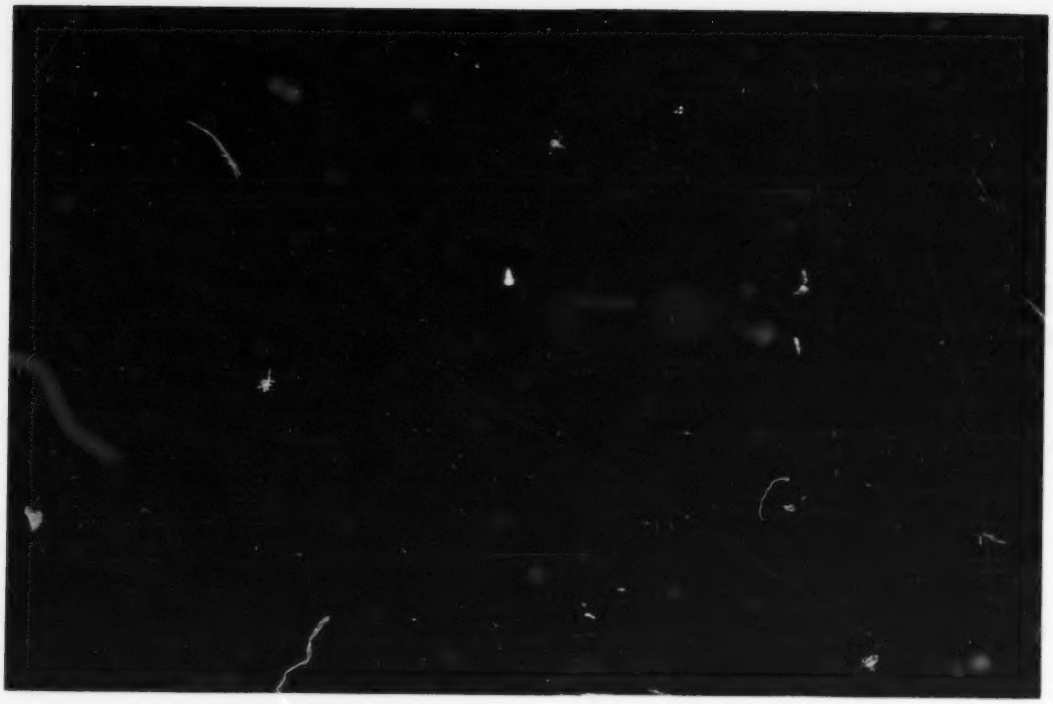


FIG G-15

MACHINED PROPELLER
(STUMP DEFLECTOR)

FIG G-16

ABOVE ARE THE VARIOUS CASTINGS, BEFORE MACHINING, FOR THE MACERATOR CAST OUT OF CA6NM STAINLESS STEEL. STARTING CLOCKWISE FROM THE LEFT HAND CORNER, THE FOLLOWING PARTS ARE SHOWN: PROPELLER (STUMP DEFLECTOR), STATIC KNIFE, FORWARDING GUIDE, AND AXIAL WHEEL.

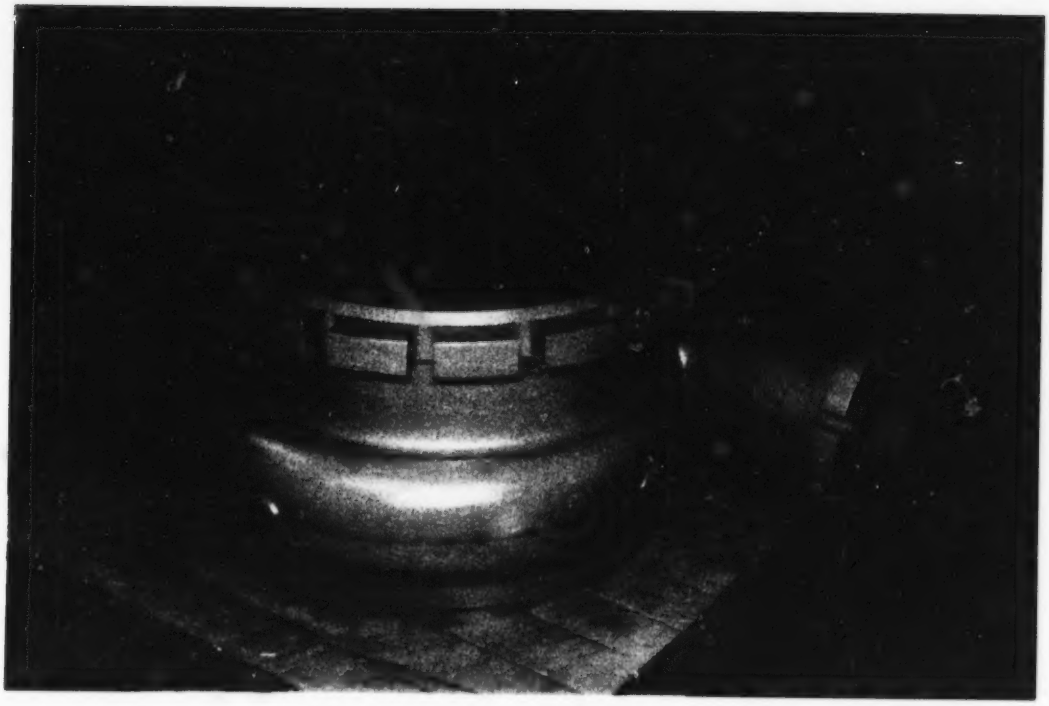


FIG G-17

PUMP CASING BEFORE MACHINING

APPENDIX H

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